UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Agricultural Economics

A STUDY OF FACTORS AFFECTING THE PRICE OF DRY EDIBLE BEANS IN THE UNITED STATES, BY CLASSES, 1922-23 TO 1934-35

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Washington, D. C.
February 1938

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CONTENTS

INTRODUCTION

The statistical series presented in this report of a statistical study of the factors affecting the prices of different varieties of dry edible beans cover the period from 1921 to 1936. The analysis of price factors is based upon price changes occurring in the years 1922-23 to 1934-35. During this time the dominant factor affecting the price of beans was found to be the income of industrial workers, more than 50 percent of the explained price variations bein, in most cases directly attributable to this factor. The heavy weight thus given to income reflects the importance of general business conditions and the price level in explaining variations in the prices of individual commodities during a period of wide cyclical fluctuations. A smaller, but still significant, part of the price variation of most classes of beans could be accounted for by changes in the production or supply of that class.

In addition, in particular cases, changes in the available quantities of some other class or classes of beans were found to affect prices to a measurable extent. The amount of production of Lima beans especially appeared to influence the prices of other varieties; and the amount of production of colored varieties likewise was a fairly definite factor in several instances. On the other hand determinable relationships between changes in Pea bean production and prices of other varieties were not established; nor could the influence of such factors as foreign bean production, and the supplies of other foodstuffs such as meat, potatoes, or rice be reliably measured by the data and methods used, although some may at times exert a certain degree of pressure on the price of beans.

An upward trend in the total production of beans that held fairly steadily during the decade of the twenties has not been maintained during the thirties. The rapid increase in the production of the Great Northern and of the Pinto varieties from 1921 to 1930 contributed largely to these trends. An increase in production of the Baby Lima, though much less striking, has been nearly continuous throughout the entire period, 1921 to 1936.

THE GENERAL SITUATION

Income from dry edible beans is of considerable importance in some States, although in the country as a whole only about 1 percent of the gross income from all crops (1931-35 average) was contributed by dry beans. In Michigan, 10 percent of income from crops was due to beans, nearly 9 percent in Idaho and Wyoming, 6 percent in New Mexico, 4 percent in Colorado and California, and 2 percent in New York and Montana. Most (nearly 98 percent) of the beans grown in the United States are produced in these eight States; Michigan and California lead with a production of 34 and 27 percent of the total average crop for the years 1924-33, and following these come Idaho with 11 percent, Colorado with 10 percent, New York with 7 percent, and Wyoming, New Mexico, and Montana with from 2 to 5 percent.

The average crop of beans for the entire 16 years, 1921-36, for which data are herewith presented, was 10,973,000 bags of 100 pounds each. By 5-year periods, the averages were 8,876,000 bags for 1921-25, 11,549,000 bags for 1926-30, and 12,481,000 bags for 1931-35. Comparisons of these figures indicate the upward trend in production that took place during this time (fig. 1). Most of the increase came in the first part of the period, for since 1929 there has been no discernible trend either upward or downward. The production of 6,085,000 bags in 1921 represented a particularly low point, for the census figure for the 1909 crop was 6,751,000 bags, while the average of the crop estimates for the years 1914-13 was 7,928,000 bags. The upward tendency is also less pronounced if per-capita figures be considered.

The per-capita disappearance of beans which averaged 9.2 pounds in the period 1921-35 increased rapidly during the first 4 or 5 years of the period, but merely fluctuated about the average level of 9.7 pounds during the period 1926-34; in 1935-36 there was a large disappearance of 11.1 pounds per capita (table 7).

Per-capita disappearance was in some years somewhat larger, in others slightly smaller, than per-capita production, depending on whether exports or imports of beans were greater, and on whether stocks were piling up or being diminished during the year (table 7). Imports have exceeded exports in most years, although usually not by large quantities. Shipments to noncontiguous territories, chiefly to Puerto Rico, were approximately 200,000 to 300,000 bags annually. Estimates of changes in stocks from one year to another and an allowance for seed and waste would give, finally, a consumption figure. The per-capita consumption in the United States appears to be about the same or more than in a number of European countries (England, France, Italy, Germany, Czechoslovakia) as well as in Canada, but less than in the Danubian, Spanish, and South American countries. 1/

1/ Based on per-capita consumption figures roughly estimated from production and trade data for all or a part of the period between 1924-30.

BEANS, DRY: PRODUCTION OF ALL COMMERCIAL CLASSES, BY GROUPS, UNITED STATES

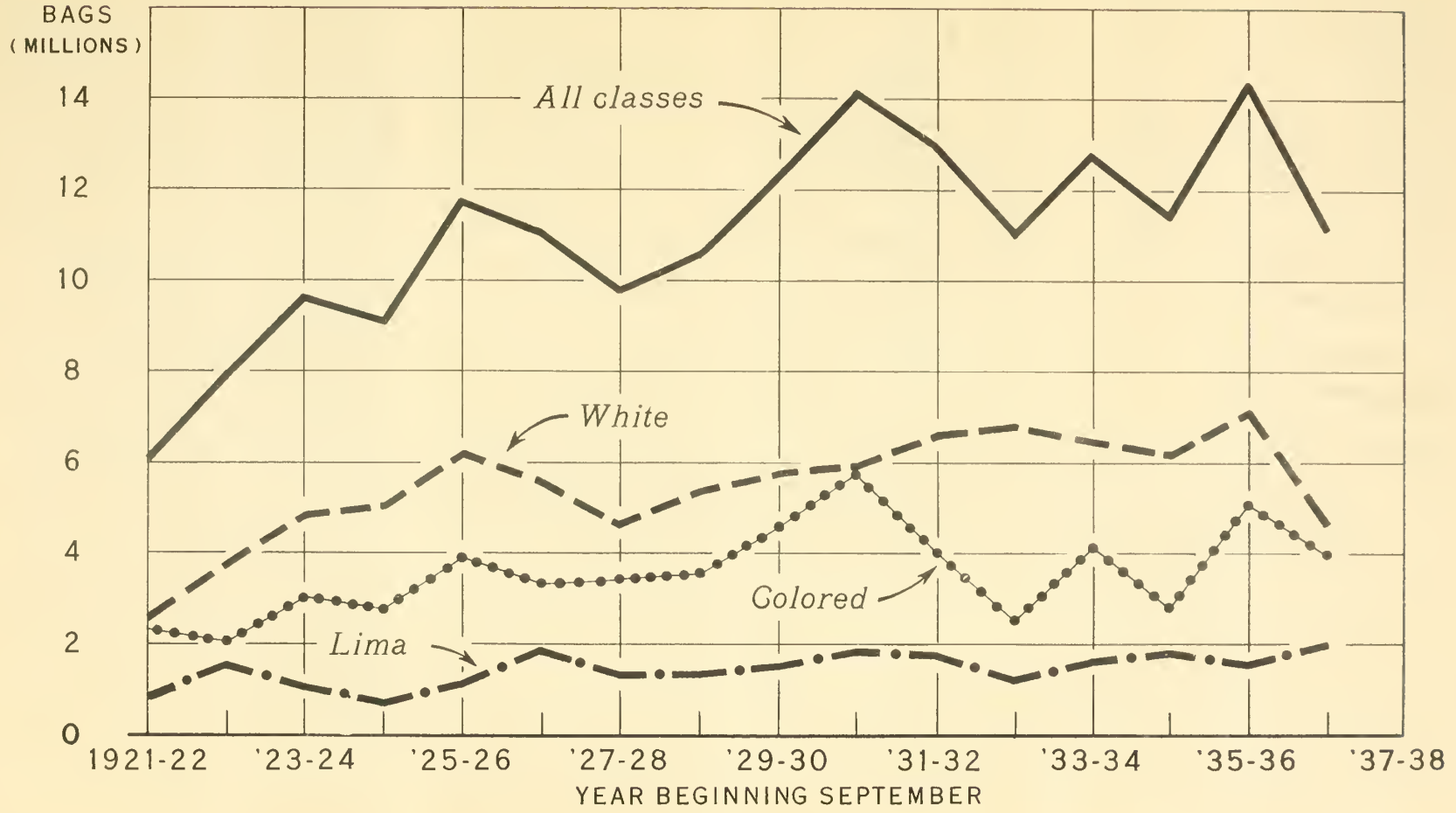

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FIGURE 1

More beans are produced in the United States than in any other country except Brazil; but production in the Danube countries, as a whole, is sometimes greater (table 5), and the Danubian crop is of considerable commercial significance because of the large exports from that region.

No indication of the importance of the Danube countries is given by the trade figures shown in table 4, because the United States imports only small quantities of beans directly from the Danube Basin. Most of the imported beans come through the concentration and trans-shipment centers of Marseilles and Antwerp (10) 2/ and perhaps from other eastern European ports. The Orient, particularly Japan, has been another important source of bean imports for the United States. South America, chiefly Chile and Argentina, sometimes provides the United States with fairly large quantities of beans, and occasionally imports from Canada or Mexico are considerable, although in some years the United States is a net exporter to these countries. The largest percentages of exports from the United States are sent to Cuba and Central America.

The foreign trade of the United States in beans declined markedly during the three depression years 1931-33. The average of the total imports in the three seasons 1931-33 was only 13 percent of the average for the period 1921-30. Reexports and domestic exports declined also, but not to the same extent, since they were at 35 percent and 25 percent of their former levels respectively. 3/ Although imports from Europe in these 3 years were almost negligible, only 3 percent of the 1921-30 average, those from the Orient were 13 percent of the 10-year average. In the following two seasons 1934-35 and 1935-36 there was a slight recovery in the volume of imports, and in 1936-37 there was a distinct increase to a higher level, while exports continued small.

In this study no attempt has been made to determine the extent to which such shifts in the foreign trade in dry beans may have been due to the increase in the tariff from 1.75 cents per pound to 3 cents per pound in June 1930, and how much to changing price relationships and other general factors which operated to decrease greatly the foreign trade in many commodities in the depression period.

One feature of the foreign trade in beans that does have some bearing on the problems under consideration, however, is the composition by varieties of the imports and exports of the United States. There are no adequate data on this point. All that is known is that the Danubian is mainly a white "pearl" bean similar to the Pea bean; that the important Japanese varieties, the Otenashi and Kotenashi, are also white beans, but that the Nagauzura and the Chunaga, mottled varieties, are also largely grown; that imports from Chile and Mexico are mostly colored beans, as are exports from the United States to Cuba and the countries in Central America.

2/ Underlined numbers in parentheses refer to literature cited, p. 53.
3/ Exports of canned beans, which reached a peak (for the period) of 16,000,000 pounds in the calendar year 1926, also declined, amounting to 3,000,000 pounds in 1933, 4,000,000 in [illegible]

The production of 18 commercial varieties in this country is reported by the United States Department of Agriculture. The relative importance of these varieties may be seen in tables 1 and 2, in which the production for each variety is shown, as well as the percentages they form of the total quantity of beans produced in each year. The varieties are grouped into the fairly definite classes of white, colored, and Lima beans, the colored being further subdivided into several groups having certain similar characteristics. About half of the domestic beans are of the white varieties, with Pea beans clearly, though decreasingly, dominant; at the same time Great Northern beans have been growing in importance from a negligible point in 1921 to a 10- to 15-percent share in total production. Pinto and Lima (Standard and Baby) beans represent about the same proportion of the total as do Great Northern beans. The Red Kidney, Pink, and Small Red are next in importance, and the remaining 20 percent of the crop consists of nearly a dozen other colored and white varieties, no one of which ever amounts to more than 5 percent of the total (except the Blackeye occasionally), and many even less than 1 percent.

Several varieties have shown a distinct upward trend in production, particularly Great Northern and Pinto beans. The production of Pinto, however, has been declining since the peak crops of 1930. There has been a slight upward trend in the production of Pea beans, perhaps, and a definite one in Baby Lima. Production of Red Kidney has declined somewhat (fig. 2).

Just as the commercial crop of beans is limited to certain sections of the country, so these districts tend to specialize in a particular variety or varieties. Thus 85 percent of the Pea beans (1924-33 average) were grown in Michigan, and 8 percent in New York; 60 percent of the Great Northern crop was raised in Idaho, and all the rest in the neighboring States of Montana, Wyoming, Colorado, and Nebraska; Colorado and New Mexico accounted for more than 90 percent ofthe Pinto crop. California has not concentrated, as the other States, on two or three kinds, but instead has produced 11 of the 18 commercial varieties reported - all the Standard and Baby Lima, all the Blackeye, Bayo, California Large and Small White, and, until recent years, when Michigan has grown increasingly appreciable quantities, all the Cranberry beans. It also grew 96 percent of the Pink, 27 percent of the Small Red, 9 percent of the Red Kidney, and a few, 2 percent, of the Pinto beans.

Each variety differs from the others in size, shape, color, or flavor, and therefore meets different tastes and preferences on the part of consumers. A study of the sectional preferences for different varieties, made by the Department of Agriculture (2), showed for instance that Pea and Great Northern beans were chiefly distributed by wholesale grocers in the year 1930-31 in most of the Northern States; Baby Lima beans were mainly consumed in the South - in Louisiana, Florida, and the Carolinas, the Standard Lima was the favorite in Pennsylvania and was also important in Maryland, New Jersey, New York, Ohio, and Illinois; the Pinto was important in the South and West - Texas, New Mexico, Arizona, Missouri, Oklahoma, and Kentucky, and Pink beans were featured in California and New Mexico. Some of the minor varieties seem to appeal to even more distinct consuming groups - the Cranberry to the miners of West Virginia and Pennsylvania, and the Bayo to the lumber and mining camps on the Pacific Coast (11).

BEANS, DRY: PRODUCTION OF PRINCIPAL COMMERCIAL CLASSES, BY GROUPS, U. S., 1921-22 TO 1936-37

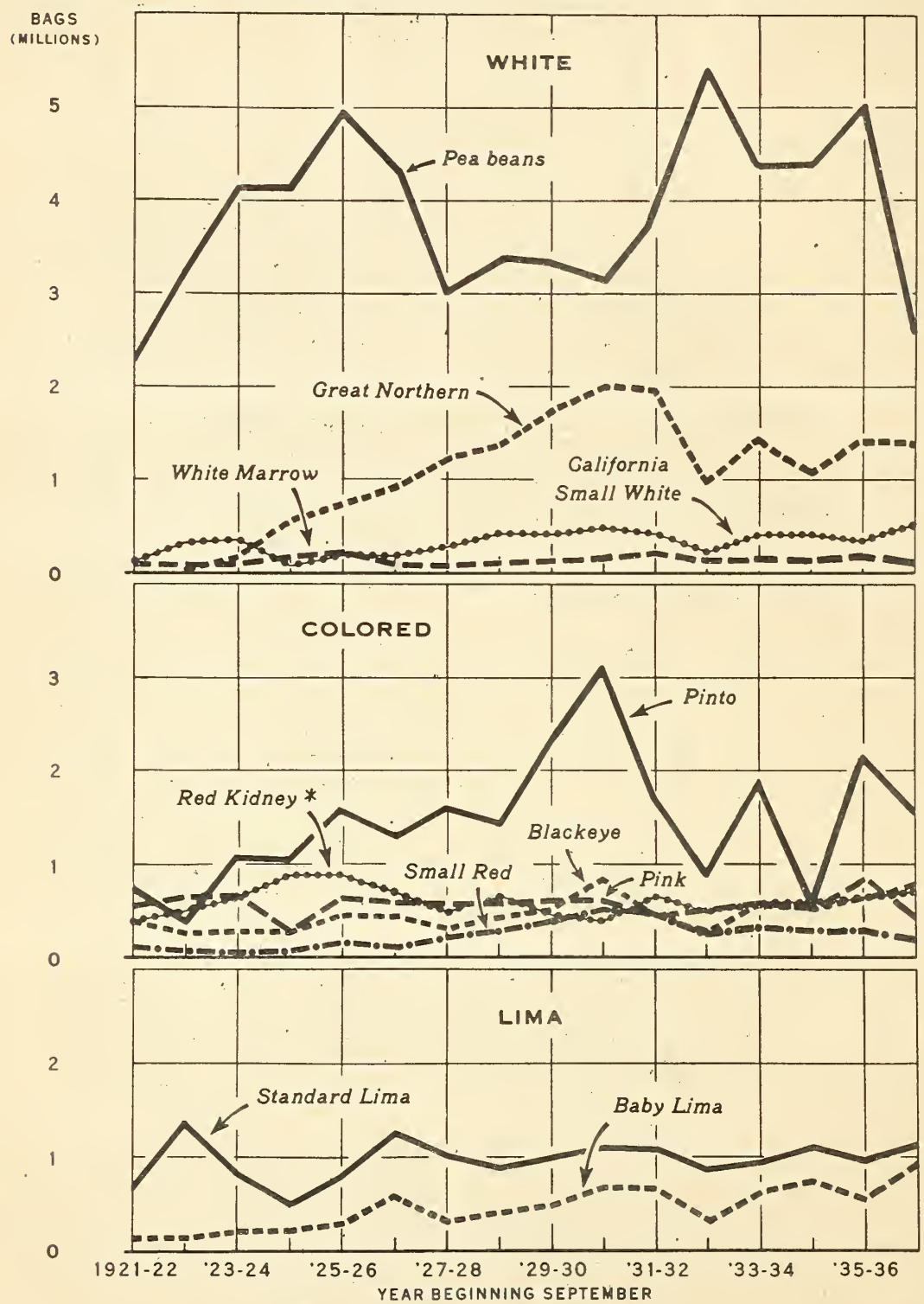


FIGURE 2

Nevertheless, there is a certain amount of substitution among all these varieties, more between some than others, and insofar as two kinds are competitive, the production of one is a factor affecting the price of the other. An attempt has been made here to discover and measure some of these relationships, as well as other more general factors influencing the prices of all kinds of beans.

PRICE COMPARISONS

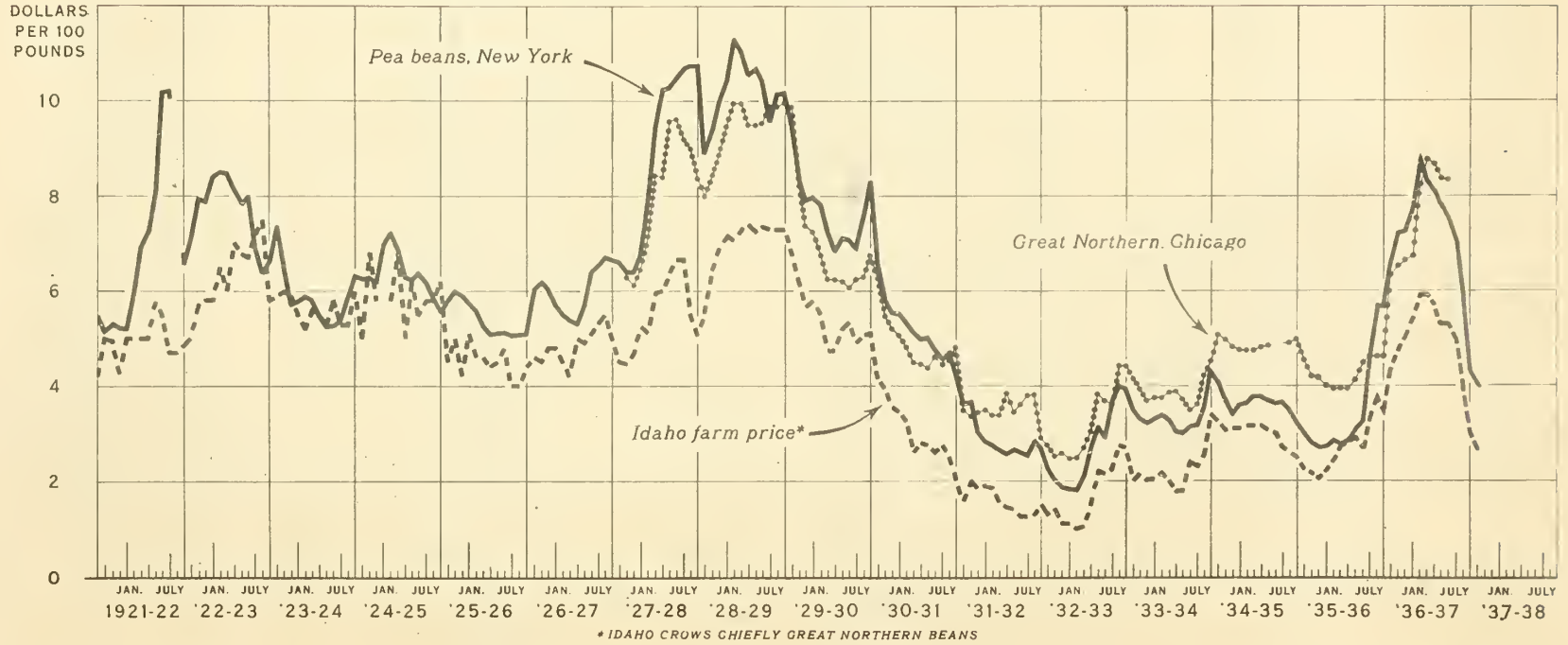
The prices of the more important varieties are shown and compared in figures 3 to 10. Certain price series show a sufficient similarity to warrant grouping them in ways already suggested by the nature of the varieties. Thus the prices of Pea beans, Great Northern, Small White, and certain foreign white beans for which partial series are available (figs. 3 to 5) show closer relationships with each other than they do with the colored varieties or with Lima beans. Other groupings thus made on the basis of price relationships are Pinto, Cranberry, and the Japanese Nagauzura, a mottled bean, as shown in figure 6; Pink and Small Red, (fig. 7); Red Kidney, (fig. 8); and Lima (Standard and Baby), (fig. 9). The annual average prices of one of the more important series from each of these classes are plotted together, in figure 10, along with the United States average farm price for all dry edible beans.

In these comparisons, the interest is centered more on a study of the movements of the prices than on the relative levels. For one reason, some of the series use farm prices (in the case of Idaho and Colorado, for example) others use California f.o.b., or New York or Chicago wholesale prices, and prices at certain foreign markets; to differing extents therefore will sorting, grading, and shipping charges, and in the case of the foreign beans, import duties, be reflected in these series. But these different charges will be relatively constant as compared with price fluctuations brought about by other factors. During the period 1921-33 the annual average Michigan farm price of beans, for instance, followed a course almost identical with that followed by the New York wholesale price of Pea beans, but at a distinctly lower level - about $1.50 per bag below the New York price.

Another cause for differentials between prices of various kinds of beans is that there is competition among them to a certain extent, not only in consuming markets, but also for the use of land. On land that is suitable for the growth of more than one variety, that kind will be planted which is expected to give the greatest net returns. This will be determined largely by price and yield conditions. The prices of lower yielding varieties will therefore tend, on the average, to be higher than the prices of those with larger yields.

For example, in a certain district in California either Pink or Small White beans may be grown to advantage (figs. 5 and 7) but the prices of the Small White have for the most part been at a higher level than the prices of the Pink (both series are f.o.b. California shipping points), but the yield of Pink beans is greater, so that the net return per acre for the two varieties has probably been about the same. (11)

PRICES OF PEA BEANS, NEW YORK, GREAT NORTHERN., CHICAGO, AND IDAHO FARM PRICE, 1921-22 TO 1937-38



* IDAHO CROWS CHIEFLY GREAT NORTHERN BEANS

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FIGURE 3

PRICES OF SELECTED VARIETIES OF BEANS, NEW YORK AND CERTAIN FOREIGN MARKETS, AND UNITED STATES TARIFF RATES ON DRY EDIBLE BEANS, 1921-22 TO 1937-38

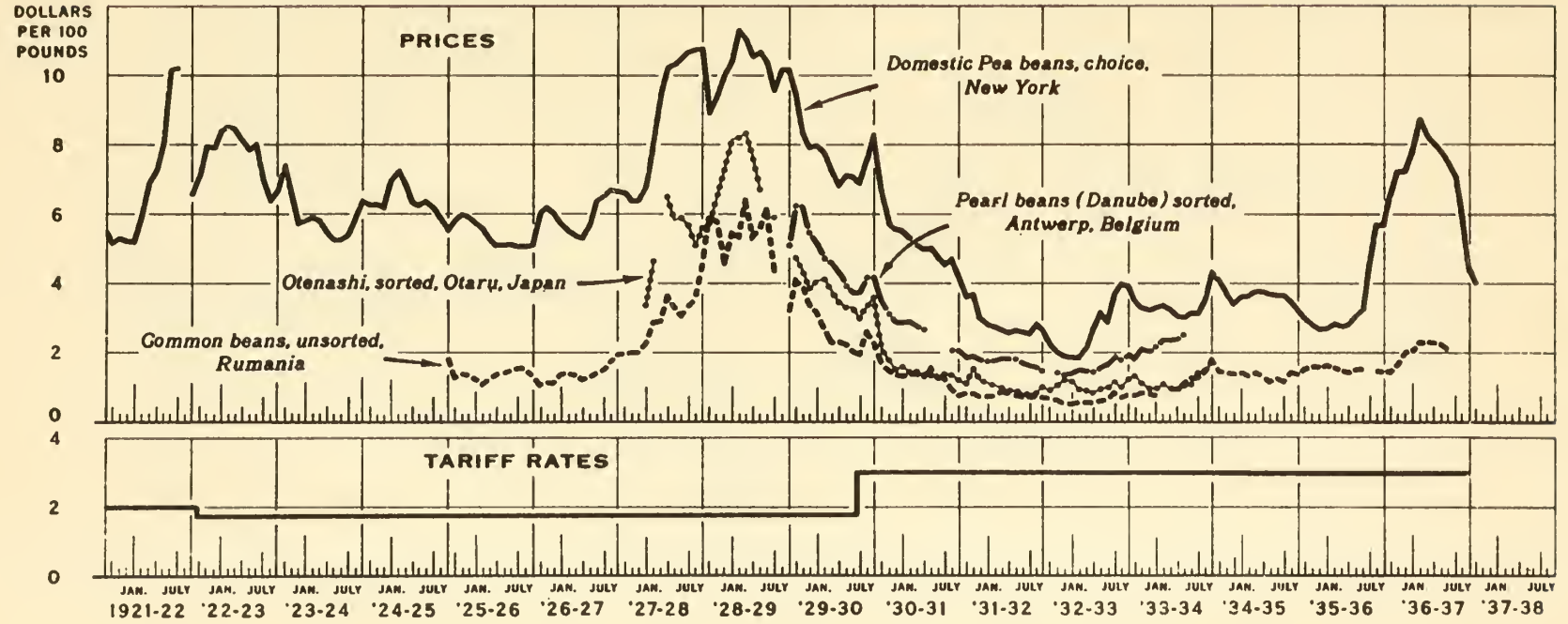

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FIGURE 4

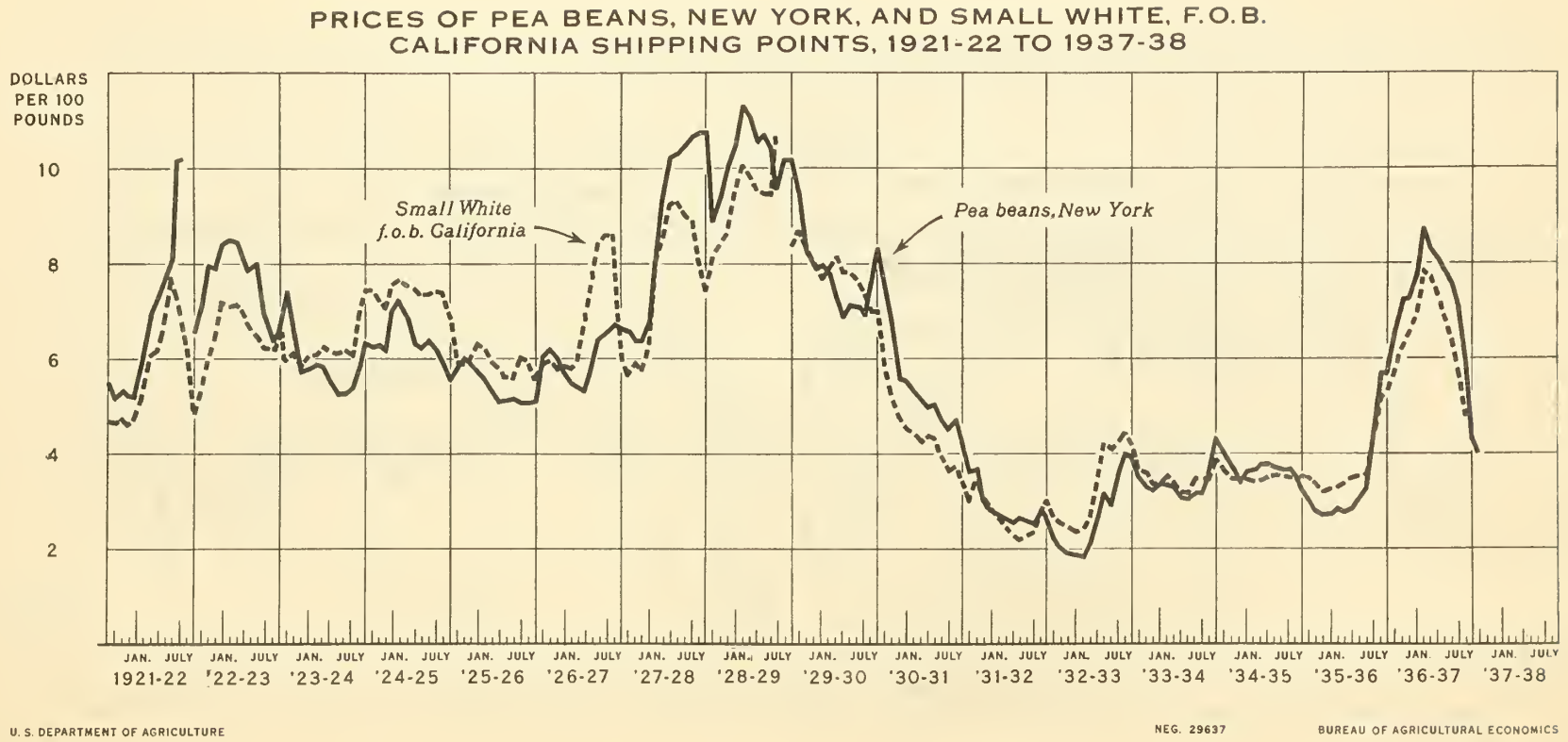
PRICES OF PEA BEANS, NEW YORK, AND SMALL WHITE, F.O.B.
CALIFORNIA SHIPPING POINTS, 1921-22 TO 1937-38
DOLLARS PER 100 POUNDS
10
8
6
4
2
Small White f.o.b. California
Pea beans, New York
JAN. JULY
1921-22 '22-23 '23-24 '24-25 '25-26 '26-27 '27-28 '28-29 '29-30 '30-31 '31-32 '32-33 '33-34 '34-35 '35-36 '36-37 '37-38
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FIGURE 5

PRICES OF CRANBERRY BEANS, F.O.B. CALIFORNIA SHIPPING POINTS, NAGAUZURA BEANS, OTARU, AND COLORADO FARM PRICE, 1921-22 TO 1937-38

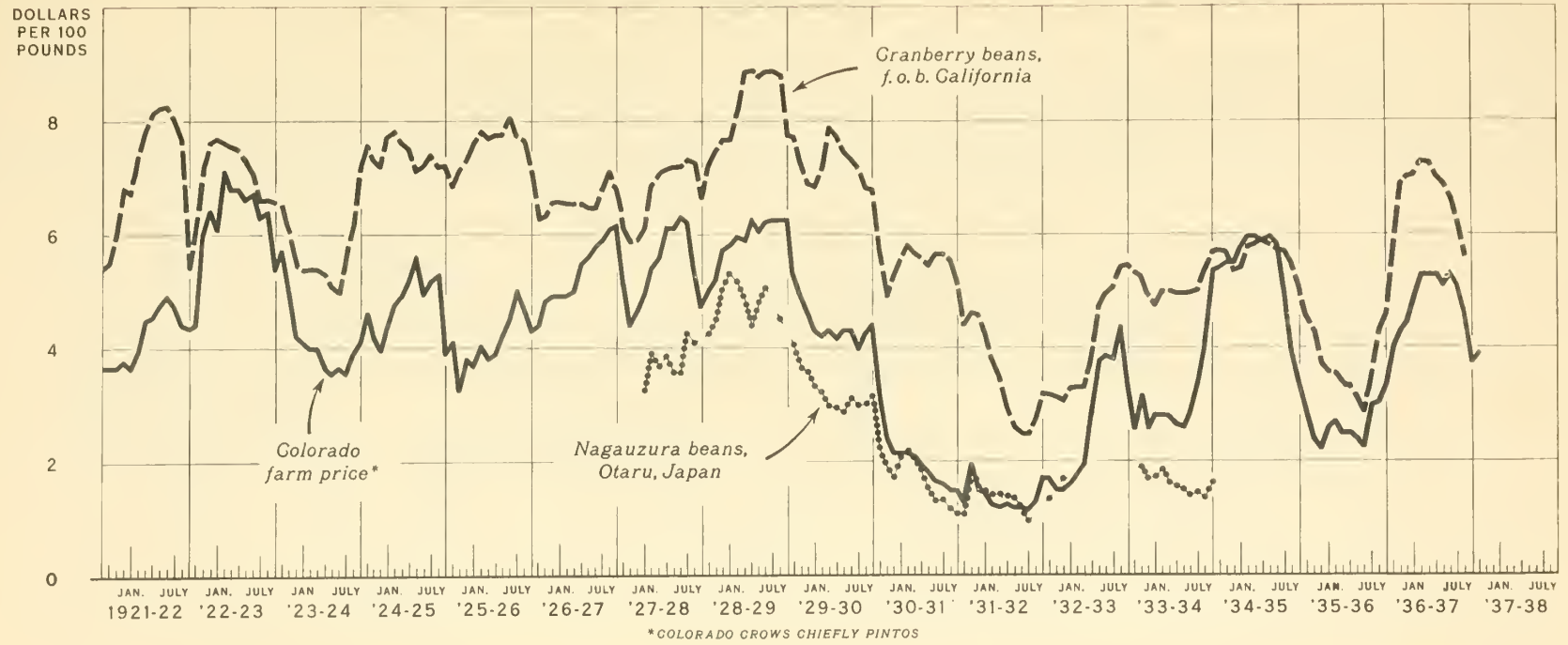

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FIGURE 6

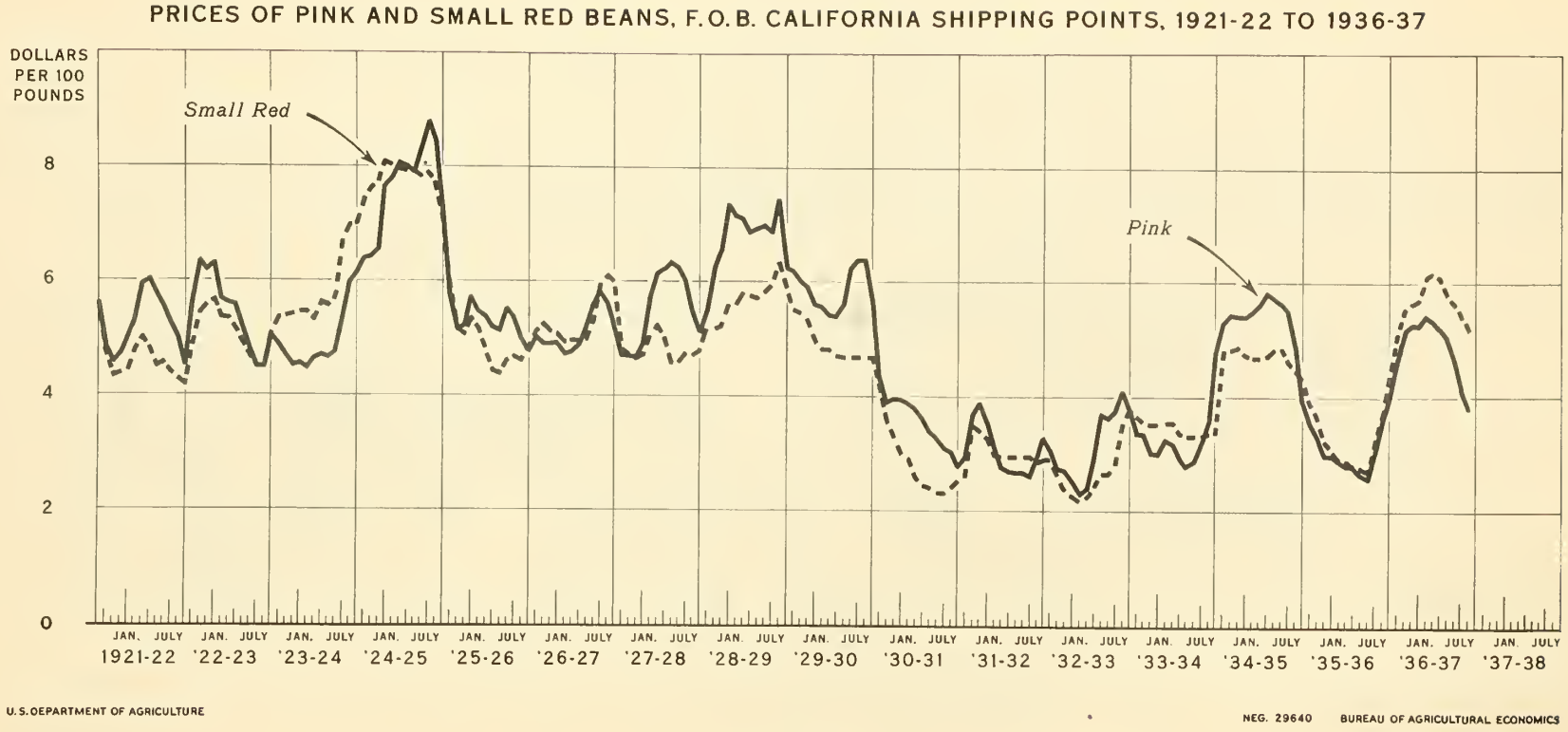
PRICES OF PINK AND SMALL RED BEANS, F.O.B. CALIFORNIA SHIPPING POINTS, 1921-22 TO 1936-37
DOLLARS PER 100 POUNDS
Small Red
Pink
8
6
4
2
0
JAN. JULY
1921-22 '22-23 '23-24 '24-25 '25-26 '26-27 '27-28 '28-29 '29-30 '30-31 '31-32 '32-33 '33-34 '34-35 '35-36 '36-37 '37-38
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FIGURE 7

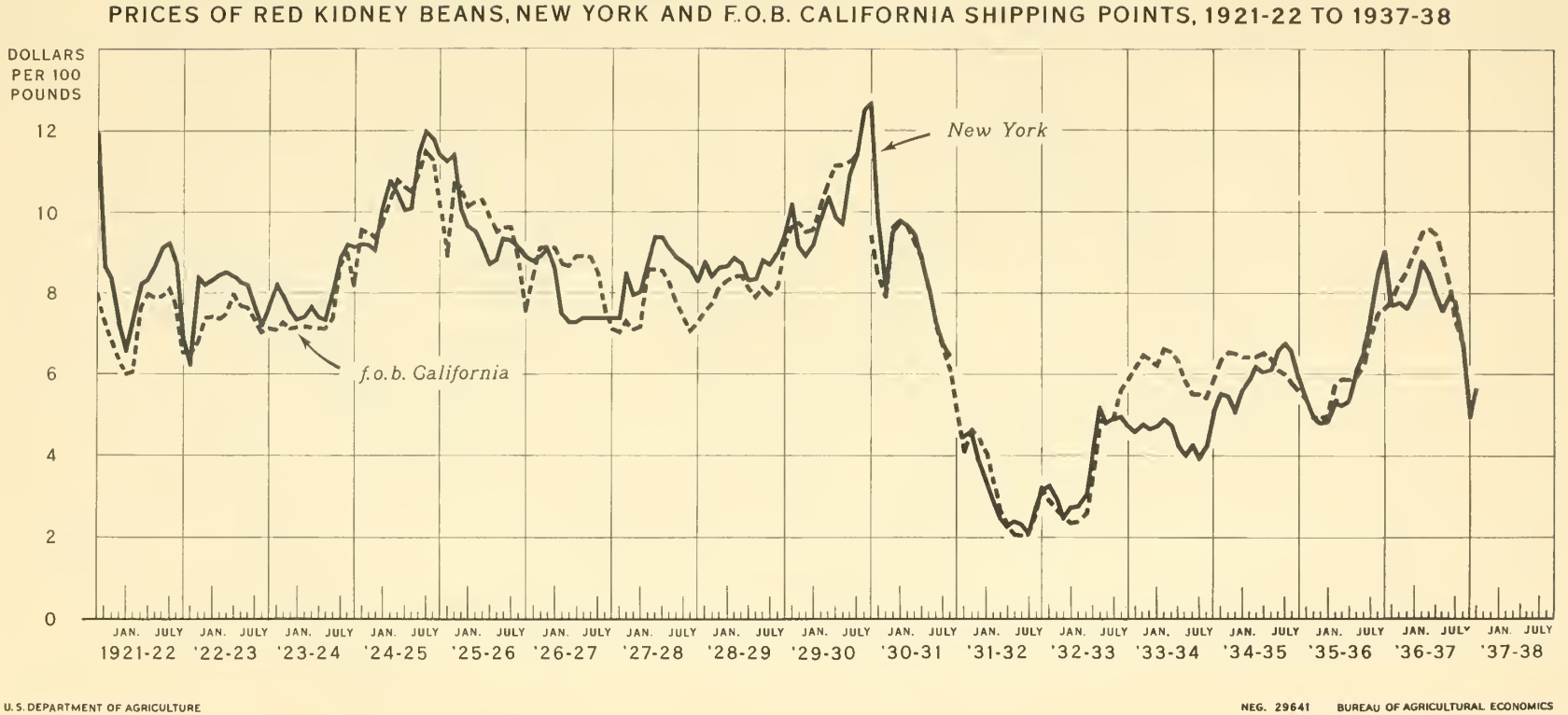
PRICES OF RED KIDNEY BEANS, NEW YORK AND F.O.B. CALIFORNIA SHIPPING POINTS, 1921-22 TO 1937-38
DOLLARS PER 100 POUNDS
12
10
8
6
4
2
0
New York
f.o.b. California
JAN. JULY
1921-22 '22-23 '23-24 '24-25 '25-26 '26-27 '27-28 '28-29 '29-30 '30-31 '31-32 '32-33 '33-34 '34-35 '35-36 '36-37 '37-38
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FIGURE 8

PRICES OF LIMA BEANS, NEW YORK AND F.O.B. CALIFORNIA SHIPPING POINTS, 1921-22 TO 1937-38

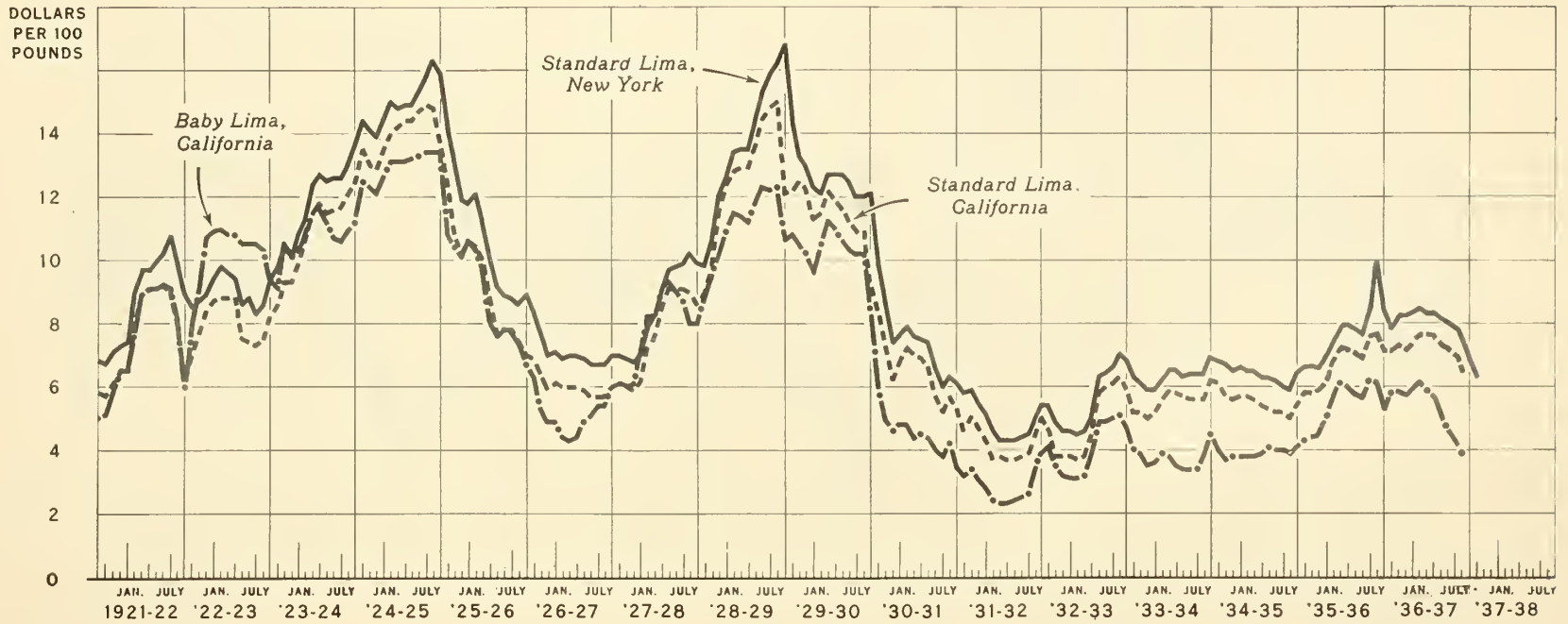

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FIGURE 9

PRICES OF SELECTED VARIETIES OF BEANS, SPECIFIED DOMESTIC MARKETS, 1921-22 TO 1936-37

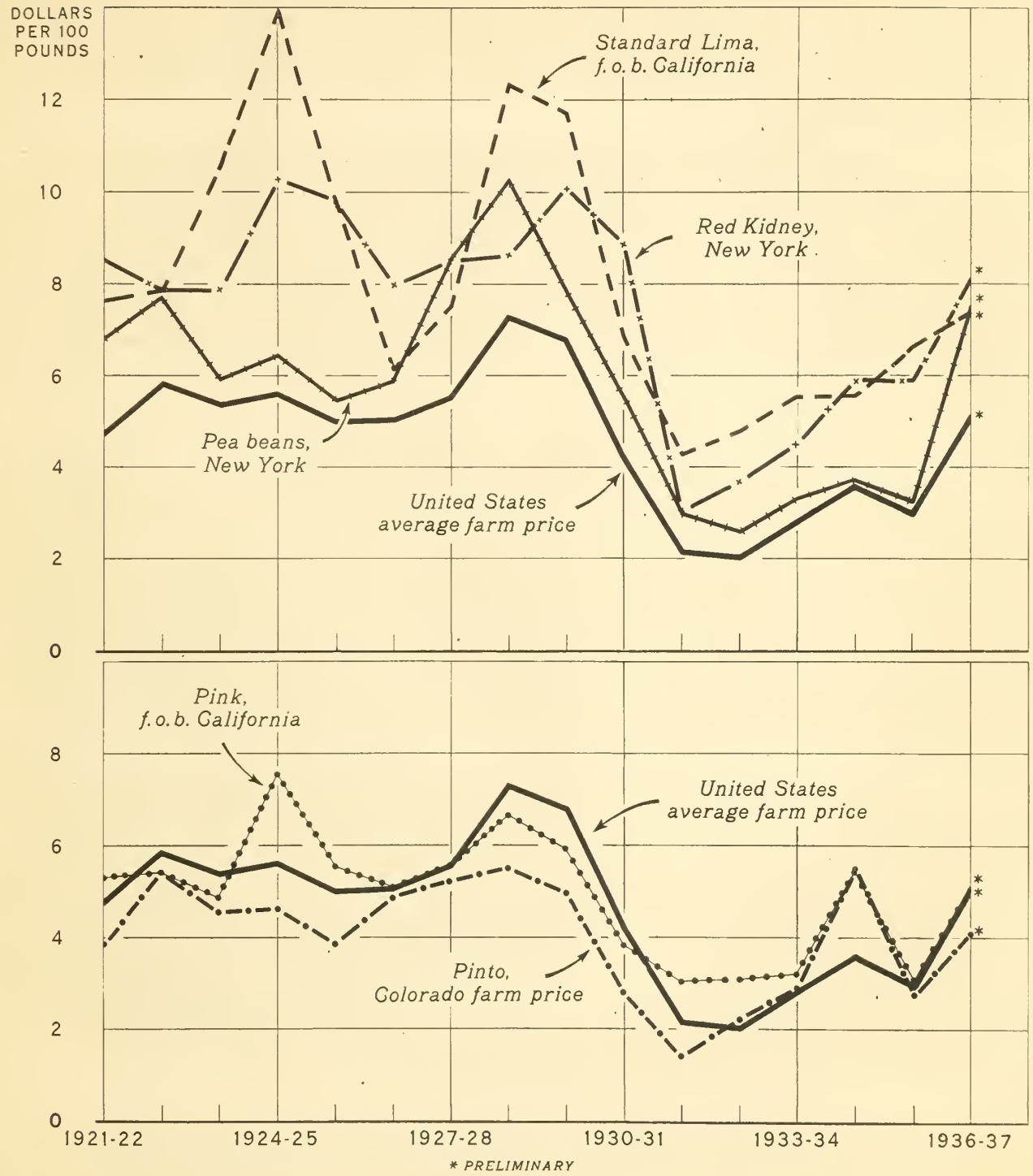

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FIGURE 10

In figures 3 to 9 in which monthly prices are given there is some evidence of a seasonal element in the series. When index numbers of the seasonal variation of the farm price of all dry edible beans were computed, May, June, July, and August were found to be the months of the highest prices on the average, while October, November, December and January were the low-priced months. The peak came in June with the index number of 104.8, and the low in November at 95.8. Here, however, only the annual average prices have been analyzed.

In considering, then, the fluctuations in the price series, some general similarities are noticed even in the five groups, such as the tendency for the prices to rise in the years 1924-25, 1927-28, 1928-29, 1932-33, 1933-34, 1934-35 and 1936-37; and particularly the sharp drop in prices between 1929-30 and 1931-32. The extent to which the several series respond to apparently general influences clearly differs. It was the problem of the study here reported to determine some of these influences or factors and their relative importance in accounting for the variations in the prices of beans. The prices of certain of the major varieties are therefore considered in some detail.

FACTORS AFFECTING PRICES

Method of Procedure.- It was first assumed that the price of each variety of beans was influenced to a certain extent by some or all of the following factors: the supplies of that variety and of other varieties grown in the United States, foreign-bean production, supplies of competing food products, and those general business conditions that appear to affect most commodities, inducing at least the major price swings. To discover through statistical techniques the most significant of these factors in each case, and to obtain measures of their probable relationships during the period considered (1921-22 to 1934-35) was the purpose of the study reported in the remaining pages of this publication.

Although in some ways it would seem most direct, and therefore, preferable, to study immediately the associated movements of absolute prices and quantities - dollars per bag and thousands of bags - it has been found more feasible to deal with relative prices and quantities. As a matter of fact, this is a realistic way of handling the data, for crop changes are frequently expressed as percentages. In 1929, for example, total production of beans was 116 percent of the crop in the preceding year (12.3 million bags as compared with 10.6 million bags in 1928); the average farm price in 1929-30 was 93 percent of the 1928-29 average. Is a 16-percent increase in production normally accompanied by a 7-percent decline in price, other things being equal? It is in terms of link relatives 4/ that the data have been expressed and the results obtained, as shown in figures 11 to 20.

4/ In this study link relatives or simply relatives are used to designate a price or quantity expressed as a percentage of the value obtaining in the previous year.

Technically, the advantage of using link relatives instead of the natural data is that in doing so there is in effect a gain in the number of independent observations available for testing the hypothesis. Correlation between successive items appeared in some of the series. For example, the correlation between the price of Great Northern beans in one year with the price in the following year was 0.79; similar correlations for the prices of Red Kidney, Cranberry, Standard Lima and Baby Lima beans were, respectively, 0.62, 0.61, 0.50 and 0.54, whereas the comparable correlation coefficients when these series were expressed as link relatives were 0.36, 0.03, 0.01, 0.24, and 0.08. That is, although an actual price was not entirely independent of the price in the preceding year, a relative price change from one year to another was independent of the relative price change that had occurred in the preceding year. In applying tests of significance to the measurements of relationships mathematically derived, the independence of the observations is assumed ((12), especially p. 261); therefore, the link relatives are statistically preferable.

Furthermore, the data are assumed to be homogeneous, as well as independent. All the series of link relatives were not tested, but several were subjected to an analysis of variance which indicated their probable adequacy in this respect. (See (5) and (8)).

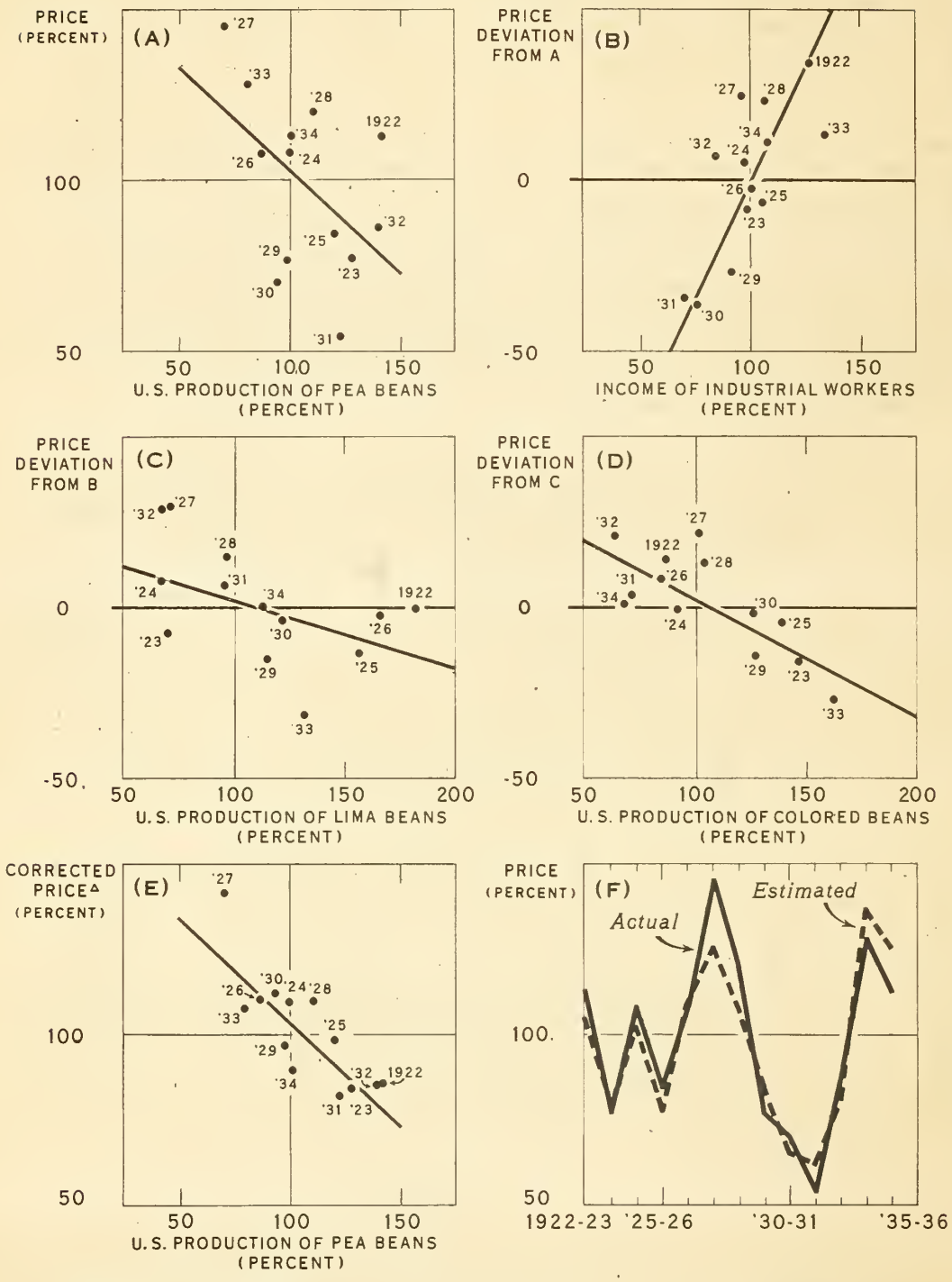
The first step in the process of determining the two, three, or four factors most responsible for variations in the relative changes in price of different varieties of beans was to sift out by the graphic method from the many factors, which on a priori grounds might be expected to influence price, those giving sufficient evidence of actually doing so to warrant inclusion in a multiple-correlation analysis. That is, the percentages of price were plotted against the percentages of production, as shown in the first sections of figures 11 to 19. Merely from inspection of the scatter of the points, regression lines were drawn in, and the deviations of the observations from the lines were plotted against the other variables. These preliminary graphic analyses are not shown here, nor are the results of all the multiple correlations that were made, for frequently some of the variables that were included on the basis of graphic evidence did not prove to be significant, as judged by the standard errors of the parameters and the partial correlation and beta coefficients. They were then omitted (with rare and noted exceptions) and new computations were made. The results thus obtained are shown in figures 11 to 19, are summarized in table 8, and are discussed in the following pages.

Pea Beans

The price selected for the analysis of Pea beans was the September-August annual average, computed from the monthly average of daily wholesale prices of choice domestic Pea beans in the New York market. New York City, in addition to being one of the most important markets for transactions in domestic Pea beans, is usually the most important port for the receipt of foreign beans.

FACTORS AFFECTING NEW YORK WHOLESALE PRICE OF PEA BEANS, 1922-23 TO 1934-35

(PREVIOUS YEAR=100)



YEAR BEGINNING SEPTEMBER

△ CORRECTED FOR INCOME OF INDUSTRIAL WORKERS, AND PRODUCTION OF LIMA AND OF COLORED BEANS

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FIGURE 11

The percentages of price were plotted against the percentages of production as shown in figure 11. Although the scatter of points is rather wide, there would seem to be some relationship between the two series. In 1927, when production was 64 percent of the 1926 crop, the average price of Pea beans was 145 percent of the 1926 level. On the other hand, in 1932 production was 140 percent of 1931, and the price 86 percent of the average for the preceding year. In general, when production increased from one year to another, prices declined, and they rose when production decreased. The slope of the regression line in section A gives a measure of this relationship.

On the average, during the period, a change of 10 units in the relative of production was associated with a change in the opposite direction of 6 units in the price relative. If, for example, current production of Pea beans were 4,400,000 bags as compared with 4,000,000 in the preceding year, or 110 percent of the last year's crop, one would estimate on the basis of this line, 5/ and assuming changes due to the other considered factors to have been taken into account, that the current price would average 97 percent of the last year's level. Supposing this to have been $6.40 a bag, the estimate for the current year would be $6.20. Had the current year's crop been 4,800,000 bags, giving a production relative of 120, the estimated price relative would have been 91, 6 units less, and the estimated price, therefore, $5.82.

But variations in production by no means explained all fluctuations in price that occurred during this period. In 1922, for example, the link relative for production was 142, very similar to that for 1932. Why, then, was the price relative 113 or 27 units above the 1932 price relative? In 1922 both production and price were higher than in 1921; another or other forces stronger than the price-depressing influence of an increased crop of Pea beans were evidently at work in this year. Those that were of measurable importance were an increase in the income of industrial workers and a decrease in the production of colored beans. But an increase in the production of Lima beans, like the crop of Pea beans, was exerting a downward pressure on price.

The most important factor accounting for price variations in the case of Pea beans as well as for most varieties was the income of industrial workers. This particular series 6/, used instead of separate measurements of business conditions and the general level of wages, has been applied as a factor in the case of each variety in the final analyses, although alternative series were also tried in the preliminary graphic studies. An attempt was made, that is, to obtain series that would reflect

5/ Or its equation: $X_1^1 = 164.4 - 0.611\ (\pm 0.159)\ X_2$ where X_1^1 = the link relative of the New York price of Pea beans, and X_2 = the link relative of production of Pea beans. The value for the slope of this line, 0.611, is nearly 4 timesits standard error, 0.159.

6/ Calculated in the Bureau of Agricultural Economics, giving a weight of 16 to factory, 3 to railroad, and 2 to mining pay rolls.

incomes by regions corresponding to the regional pattern of the consumption of beans by varieties, as determined by Barr's study (see above, p. 5). Thus, Barr's findings indicated that in 1930-31 about 77 percent of the reported Pea beans were distributed for consumption in the eastern and central manufacturing States; regional index numbers were constructed which might more nearly approximate changes in income of the majority of consumers of Pea beans than would the more general index showing changes in the incomes of industrial workers throughout the country. Such special income series were also computed for use with the prices for Pinto, Pink, Small Red, and Cranberry beans. With this last class, index numbers of mining pay rolls were tried.

Nevertheless, after some experimentation, it was decided that, although the method was theoretically desirable if both regional and income patterns were known more accurately, the results obtained were not sufficiently conclusive nor different to offset certain advantages gained from using the one representative series of total industrial income. Index numbers of national income might have been used instead of industrial pay rolls, but since beans are probably consumed more largely by the lower income groups than by the higher, it was felt that an index of industrial income would more accurately measure shifts in the demand for beans.

As may be seen in section B of figure 11, where vertical deviations of the observations from the regression line in section A are plotted against link relatives of the income of industrial workers, a number of the widest departures of price from what might have been expected merely from changes in the size of the Pea bean crop can be explained by changes in workers' incomes.

In both 1930 and 1931 the average price of Pea beans was actually far below the price that would have been estimated from production alone; but in each of those 2 years industrial income fell markedly from the preceding year. In 1922 the actual was well above the price estimated from production, and in this year there had been a definite increase in income over the 1921 level. In terms of the slope of the regression line, the average relationship between the price of Pea beans and the income of industrial workers was such that an increase or decrease of 10 units in the link relatives of income was associated with an increase or decrease of 13 units in the price percentages. Since the value of this slope is nearly six times its standard error, it may be accepted with some confidence that the relationship is a real one and not merely due to chance.

The slope measuring the relationship between link relatives of the price of Pea beans and of production of Lima beans, however, is only twice its standard error, and the probability that it is significant is therefore not so great as in the preceding case. The regression line is shown in section C of figure 11, where the price deviations from the line in section B are plotted against the link relatives of total production of Lima beans - Standard and Baby. An increase or decrease of 10 units in the Lima crop percentages, was associated on the average

with a decrease or increase of slightly less than 2 units in the link relatives of price. A similar change in total production of all varieties of colored beans was associated with a somewhat larger average price change in Pea beans, 3.4 units. This slope (see section D, fig. 11) is nearly three times its standard error.

These relationships between the price of Pea beans and some of the more important factors which affect it have all been expressed in terms of the slopes of the regression lines which are, of course, in link-relative units. It is sometimes interesting to consider percentage changes in these units. If production is at a given level in link-relative terms, and then increased by a small amount - say by 1 percent - what will be the percentage change in price? This percentage change in price will depend upon the level of the production relatives under consideration; it differs, that is, at different points on the regression line. In 1926, for example, production was 87 percent of the 1925 crop and the estimated price (assuming average changes in the other factors) was therefore 111 percent of the 1925 average. If, then, the production relative were increased by 1 percent, price would have decrease by 0.48 percent. On the other hand, in 1932 when the link relative was 140.1 and the estimated price relative 78.8, a 1-percent increase in production would have brought about a fall of slightly more than 1 percent (1.09) in price. For comparative purposes it is ordinarily convenient to state such flexibilities of price 7/ at the points of average. The average of the production relatives over the 13-year period is in most cases somewhat larger than 100, indicating an average upward trend in production. This difference, however, is not great, and importance need not be attached to the fact that the regression lines shown in the charts do not go through the points of "no change", that is, the point where no change in production from the previous year (100) is accompanied by no change in the price level. At this point the flexibility of price would be exactly equivalent to the slope of the line. Since the flexibilities of price at the points of averages do not, in the cases shown in this study, differ significantly from the slopes, it is sufficient for comparative purposes to refer merely to these slopes.

Since all variables are given in link-relative units, the slopes of regression lines may be compared as indicative of the relative importance of the factors in explaining the price variations during the period. It may be noticed, however, that the range in values of the link relatives of production of colored beans from 63.4 in 1932 to 162.3 in 1933 was somewhat larger than the range of industrial income, from 69.8 in 1931 to 131.7 in 1933 8/. Now, even with a steeply sloping

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7/ Flexibilities of price are the reciprocals of the elasticities of demand. $\varphi = \frac{1}{n} = \frac{\partial y}{\partial x} \cdot \frac{x}{y}$, where y is price and x a quantity factor. Unless otherwise stated, all flexibilities in this study are for points at the means.

8/ The standard deviations are 17 for income and 37 for production of colored beans.

regression line in link-relative units, if the average deviations of the quantity factor about its mean are small, it will not serve to explain very wide fluctuations in price. A measure taking both the slope and relative deviation of each factor into account, indicates that 27 percent of the total price variation was directly attributable to the production of Pea beans, 84 percent to industrial income, 8 percent to production of Lima beans, and 18 percent to production of colored varieties 9/. After taking into account joint effects of the variable in the opposite direction, it may be said that 87 percent of the price fluctuations occurring during the period could be explained by the four independent factors, leaving 13 percent of the variation unexplained. By comparing the scatter of the observations about the equivalent lines in sections A and E of figure 1, the extent of this reduction in the variance of price may be seen graphically.

Another measure of the relative importance of each of the independent factors is given by the partial correlation coefficients, which give the correlation existing between price and each of the independent variables after the influence of the other factors has been taken into account. The correlation between link relatives of price and production of Pea beans, with the obscuring effects of changes in income and the production of Lima and colored beans eliminated, was -0.80. Similar partial correlation coefficients of price with industrial income, production of Lima beans, and production of colored beans were 0.90, -0.57, and -0.72 respectively.

Although these various measures differ numerically, they are consistent in ranking the income of industrial workers as the most important of the four considered factors. As one would expect, the production of Pea beans had more influence on the price of Pea beans than the production of colored beans, which, in turn, was of greater importance than Lima-bean production.

Another method of showing the final results obtained from the use of the equation is given in section F of figure 11, where actual price relatives and estimated price relatives are plotted as time series, the differences between them being equivalent to the deviations of the observations from the regression lines in either section D or section E. The coefficient of correlation between these actual and estimated price relatives is 0.93 10/.

9/ The variation in the dependent variable directly attributable to each of the separate factors is measured by the beta coefficients (squared), where $B_{1n.23\ldots(n-1)} = {}^{b}_{1n.23..(n-1)}\frac{\sigma_n}{\sigma_1}$. Coefficients of determination ($B_{1n.23..n}r_{1n}$) measure the total, direct and joint, contributions to the reduction in the variation of the dependent variable made by each independent variable. The sum of the coefficients of determination is equal to the multiple correlation coefficient (squared). For an explanation and criticism of these statistical measures see Mordecai Ezekiel, "Methods of Correlation Analysis," especially pp. 380-383.

10/ That is, $R = 0.931$; $\bar{R} = 0.894$. $\bar{R}$ is the multiple correlation coefficient when the reduction in the number of degrees of freedom by 5, the number of constants in the equation, is considered.

That there still remains some unexplained variation in the price relatives is, of course, not at all surprising. Some of the factors considered graphically, but discarded because of the lack of evidence of a sufficiently well-defined and measurable relationship, may nevertheless have exerted a certain degree of pressure on price in particular years. Other forces having doubtless a greater or less influence have not been taken into account at all, such a nonmeasurable factor is the quality of the crop, for example; or such a supply factor as carry-over for which adequate data are lacking; or the supplies of other competitive foodstuffs. Tariff duties, which have changed twice during this period, may also have affected price fluctuations. A discussion of remaining deviations in terms of such possible explanations is given later, when the prices of other varieties of beans have been analyzed and comparisons of the final residuals can be made.

Great Northern Beans

As may be seen from tables 1 and 2, the growth in production of the Great Northern has been marked, both absolutely and relatively. In 1922 when this variety was first reported, there was a crop of 29,000 bags; in 1923 production was more than five times as large (165,000 bags) and in 1924 the crop was more than tripled (594,000 bags). Increases thereafter were continuous through 1930, but in percentage terms they ranged from about 15 to 30 percent each year.

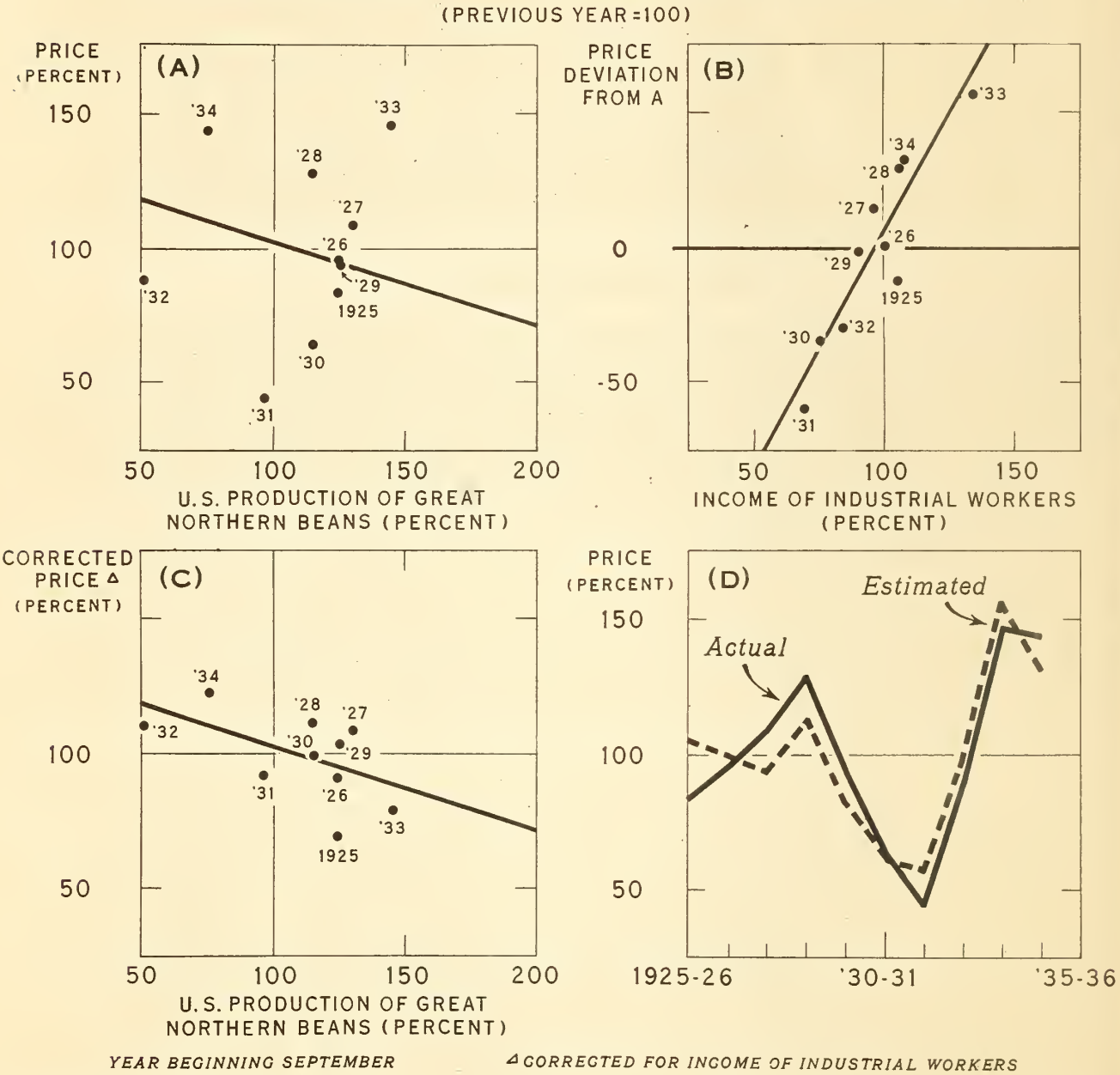
These circumstances make the problem of price analysis difficult. It seems probable that during this period when production was increasing very rapidly, and this variety was gaining favor among different consuming groups, the demand curve for Great Northern beans was changing shape or shifting in such a way as to prevent its satisfactory determination by the methods and statistical series here used. Nevertheless, the attempt has been made.

To obtain a more homogeneous series, the period has been shortened somewhat arbitrarily to cover the years 1924 to 1934 which gives only 10 link-relative observations. The Idaho farm price was selected for analysis. A series of market prices quoted definitely for this variety is available only since 1927-28 when regular quotations were given for the Chicago market. Later (1930-31) prices were also quoted in New York, indicating the widening market, but these series are shorter than is desirable and the Idaho farm price seems sufficiently satisfactory. Of the total production of Great Northern beans, 61 percent is grown in Idaho; and 64 percent of Idaho's bean crop is of this variety 11/. Variations in the Idaho farm price, as may be seen in figure 3, have corresponded quite closely to those in the Great Northern prices in Chicago since 1927-28, with a certain differential.

Following the same procedure as with Pea beans, link relatives of the Idaho average annual farm price were plotted against the link relatives of production of Great Northern beans, and the deviations from the regression line of the price on production relatives were plotted, first against relatives of the income of industrial workers, and then

11/ These are 1924-25 to 1933-34 averages.

FACTORS AFFECTING IDAHO FARM PRICE OF BEANS (GREAT NORTHERN), 1925-26 TO 1934-35



YEAR BEGINNING SEPTEMBER

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FIGURE 12

the residuals from this second regression line were tried with such series as the link relatives of the production of Pea and other white beans, colored varieties, and Lima beans, of cattle inspected for slaughter, and foreign (Danube) production.

Of these factors, three in addition to Great Northern production and industrial income, namely, production of white varieties (excluding Great Northern) and of Lima beans, and cattle inspected for slaughter, gave sufficient indication of relationship with the price to warrant inclusion in a correlation analysis. Only one of these, however, the income of industrial workers, definitely met the tests indicating that its relationship with Great Northern price was significantly determined. The slope of the regression line of link relatives of price on production of the Great Northern was somewhat less than twice its standard error; nevertheless, this factor was used, along with income, in the analysis presented in figure 12.

An increase of 10 units in the link relatives of production was associated during the period, as may be seen in section A of figure 12, with a decrease of 3.2 units in the relatives of price; or, as indicated by the flexibility of price at the means, a 1 percent increase in production would have brought about a decrease in price of 0.36 percent. This factor served to explain directly about 8 percent of the total variance in price. These measurements, however, cannot claim to be reliably determined 12/, and it is suggested that a longer period in which the position of the Great Northern is more or less definitely established in the general consumption pattern of dry edible beans than is at present available is needed before the price-quantity relationship can be more accurately defined.

A comparison of the scatter of points about the equivalent regression lines in sections A and C of figure 12 shows, nevertheless, that a considerable reduction in the scatter was effected, largely because of the factor of industrial income. A 10-unit increase in the link relatives of income tended to increase the link relatives of price by nearly 18 points. The price of Great Northern appears to have been even more sensitive than the price of Pea beans to general business conditions insofar as they were reflected in the income of industrial workers. The partial correlation coefficient between price and income relatives was 0.91.

Actual and estimated price relatives are shown in time-series form in section D of figure 12. The correlation between these two series is 0.91 ($\bar{R}$ = 0.88). A discussion of possible explanations of some of the more striking divergences will again be deferred till a later section.

12/ The slope of price on production is 1.6 times its standard error. The partial correlation coefficient between the relatives of price and production, with the influence of relatives of industrial income taken into account, is -0.51, but, considering the few degrees of freedom (7), a correlation as high as this due to chance alone, might be expected about once in 10 times.

Pinto Beans

Two or three times as many Pinto beans are grown as any other one-colored variety; and this class comprises about 15 percent of the total bean production in the United States. As was the case for the Great Northern, however, records of regular central-market prices were not available until 1926-27, and in order to get a longer series, the Colorado farm price was used. Since Pinto beans grown in Colorado form 63 percent of the total Pinto crop and 94 percent of Colorado's bean crop, this farm price may be considered as reasonably representative of the prices of the Pinto.

One of the striking features of Pinto production as contrasted with the production of other classes has been its variability; the annual fluctuations in the size of the Pinto crop have been proportionately greater than has been true for other bean varieties. 13/ The range in the values of Pinto-production relatives was thus considerably larger than for the other classes, and it is essentially this circumstance that has necessitated a somewhat different type of analysis.

A linear relationship between price and the quantity factors has hitherto been assumed, and the graphic evidence indicated that this was sufficiently accurate, at least as a first approximation. In the case of Pea beans, for example, it was shown (see above, p. 19) that a 10-point increase in the production relative was accompanied on the average by a 6-unit decline in the price relative (other factors remaining the same), and this held true whether the increase in the link relative of production was from 70 to 80 or from 130 to 140. The range in the production relatives during the considered period, however, fell approximately within these limits - from 70 to 140; it would not be safe to assume that if the production relative changed from 140 to 240, let us say, the price relative would fall 60 units, for the decline might well be less this amount. Nor can we assume that, if the Pea-bean production relative were to decrease from 70 to 30, the price relative would rise by 24 points; it is not unlikely that the rise might be even greater than this.

The graphic analysis of the Pinto data indicated that the relationship between the relatives of price and production was nonlinear, and that a given absolute change in the size of the production relative had a greater price effect when the production relatives were small than when they were large. This relationship is shown by the curved line in section A of figure 13. 14/ When the production relatives fell within what might be called the normal range of values, say from 50 to 150, a change of 10 points was accompanied by a change in the opposite direction of approximately 4 points in the estimated price relative; but within the range 150 to 300, a 10-unit increase in the size of the production relative was associated with only about a half unit decrease in the price relative. On the other

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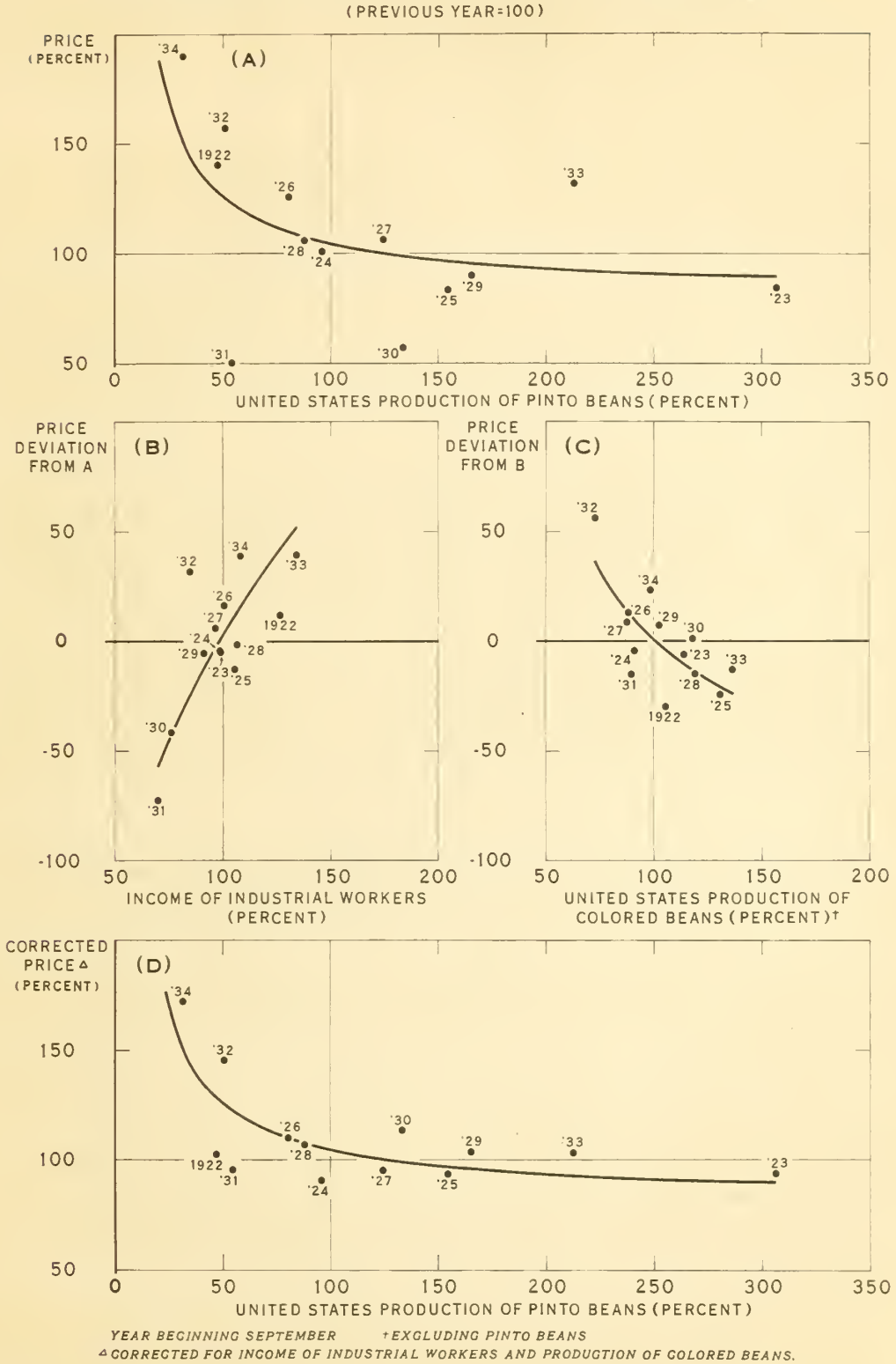
13/ The standard deviation of the link relatives of Pinto production was 74 as compared with 39 for Cranberry beans, 37 for total Lima production, 35 for Red Kidney, 27 for Great Northern, and 21 for Pea beans.

14/ The equation to the line is $X_1' = 826 + 0.217\ (\pm\ 0.074)\ X\ X_2'$ where X_1 is the price and X_2 the production relative.

FACTORS AFFECTING COLORADO FARM PRICE OF BEANS (PINTO), 1922-23 TO 1934-35



YEAR BEGINNING SEPTEMBER †*EXCLUDING PINTO BEANS*

△*CORRECTED FOR INCOME OF INDUSTRIAL WORKERS AND PRODUCTION OF COLORED BEANS.*

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FIGURE 13

hand, an approximate increase of 13 points in the price relative accompanied a 10-unit decrease in the production relative within the 30 to 50 range of production values. The flexibility of price differs, of course, at every point on the curve, but it is interesting to see that it remains numerically less than unity throughout the observational range; at the mean of the production relatives it is -.18. 15/

The relationship between price and industrial income as shown in section B of figure 13 is likewise indicated by a curved rather than by a straight line. 16/ The price change corresponding to a given absolute change in the link relatives of the income of industrial workers is somewhat less when the income relative is large than when it is small. The curvature within the range of observed values is not very great, however, and although this form might have been used in the analysis of other varieties, it is felt that the gain in accuracy would have been slight. On the average, a 10-point increase in the income relative was accompanied by an approximate increase of around 15 points in the price relative.

The gain in accuracy from assuming a nonlinear relationship with price is likewise probably slight in the case of link relatives of production of other colored varieties. As may be seen in section C of figure 13, a change of 10 units in the production relative when the change fell within the range of about 90 to 115 was accompanied by approximately the same change (in the opposite direction) in the Pinto-price relative, a somewhat smaller change when the production relative was larger, and greater when the production relative was less than 90. 17/ In terms of flexibilities, a 1-percent increase in production of other colored beans at the mean would have been accompanied by 0.82 percent decrease in Pinto price; a 1-percent increase in production in 1933 would have brought about 0.79 percent decrease in price, and the comparable change in 1932 would have been -0.87.

Of the three factors found to affect Pinto price significantly, income of industrial workers was the most important, 59 percent of the reduction in variance of price being directly attributable to it, while 20 percent was directly attributable to Pinto production and 18 percent to production of other colored varieties. The partial correlation coefficients of these three factors with Pinto price indicated the same order of importance. 18/

15/ When X_2 is 31.7 (the value for 1934) $\alpha = -0.45$; when X_2 is 306.5 (the value for 1923), $\alpha = -0.08$.

16/ The equation is $X_1^{11} = 766.6 + 384.7\ (\pm\ 0.765) \log. X_3$ where X_3 = link relatives of industrial income.

17/ The equation is $X_1^{11} = -91.6 + 0.927\ (= 0.372)\ X4^{1}$ where X_4 is the link relative of total production of colored beans (excluding Pinto production).

18/ They were 0.86, 0.70, and 0.64 respectively; it should be noted that the link relatives of price are correlated with the logarithms of link relatives of income, and the reciprocals of the production relatives which explains the positive sign of the latter two coefficients.

As before, the reduction in the scatter through the use of the equation may be observed by comparing sections A and D of figure 13. The correlation between actual and estimated price relatives is 0.32 ($\bar{R}$ = 0.89).

Pink Beans

The Pink, though forming only about 5 percent of the total bean crop of the United States, is among the more important of the colored varieties. As the commercial crop is produced almost entirely in California, the price of Pink beans, f.o.b. California shipping points, was used. Also, as in the case of all the California varieties, a carry-over figure is available in the form of stocks held in California warehouses as of September 1. Stocks added to the production estimates give the available supply of Pink beans, which should be a more accurate quantity series to consider as an influence on price than merely the size of the crop.

The factors found to be most significant in explaining the price of the Pink are, beside the supply of Pink beans, the income of industrial workers, total production of colored varieties other than Pink, and production of Lima beans. The methods of analysis were the same as before, although linear relationships were assumed between the link relatives of price and quantity factors.

The slope of the regression line of price relatives on the supply relatives of Pink beans is rather steep - steeper than in comparable cases with the other varieties. A 10-point change in the percentages was accompanied by an opposite change of 8.6 points in the price relative 19/ (see section A, fig. 14).

Income of industrial workers was again the most important of the factors, and the relationship with price was an average one, for a 10-unit increase in the income relative tended to increase the price relative by 14.1 units (see section B, fig. 14).

Equal increases in the relatives of production of colored (excluding Pink) and of Lima beans influenced the price of Pink beans to almost the same extent - 10-point increases or decreases in the production relatives changing the price relatives, in the opposite direction, by 3.4 and 3.2 points, respectively 20/ (see sections C and D of fig. 14).

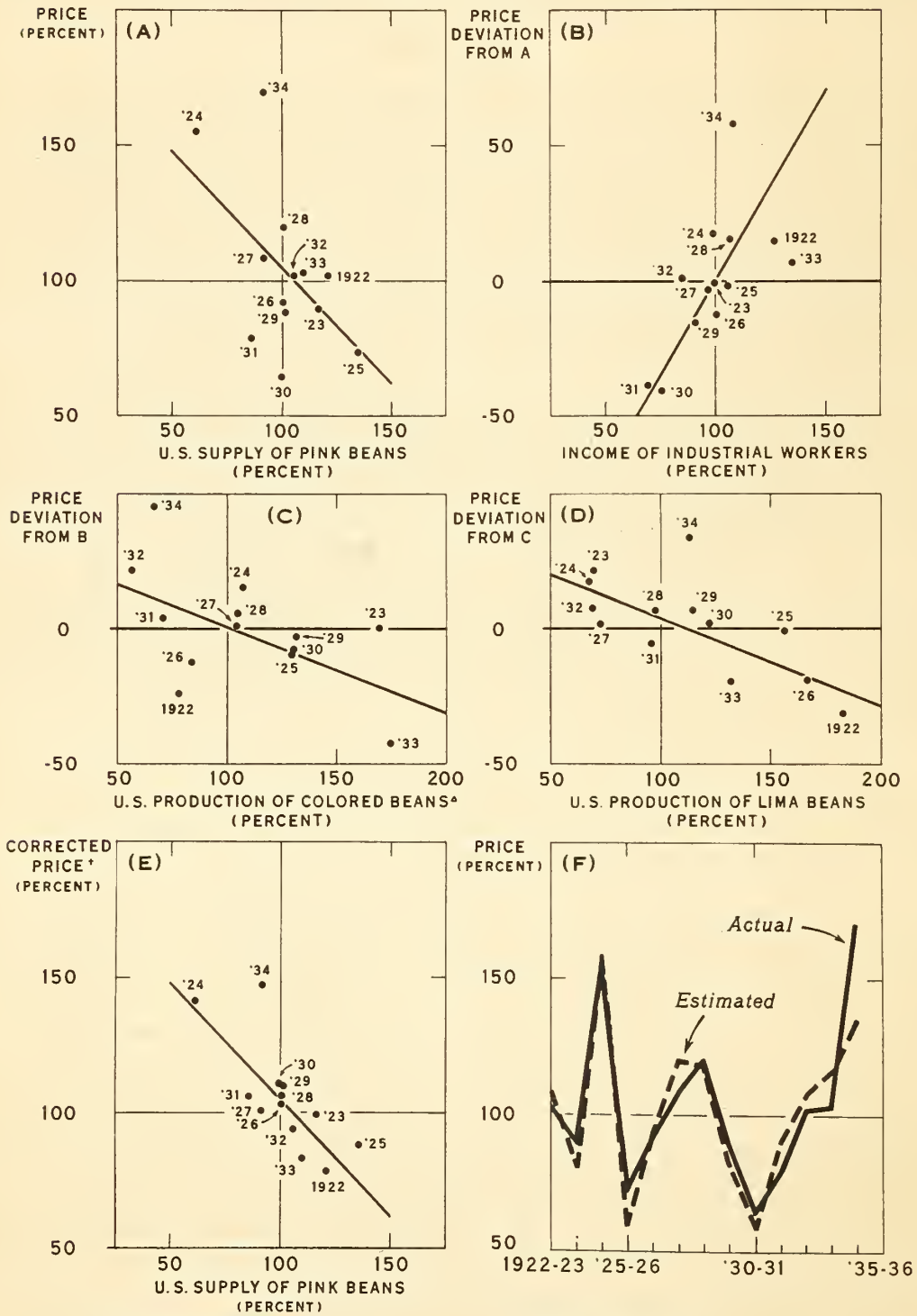
A comparison of sections A and E of figure 14 indicates the extent to which the use of these factors explained price variations during the considered period (81 percent was thus explained of which 28 percent was contributed, directly and indirectly, by the supply of Pink beans, 28 percent by income, 13 percent by production of colored varieties, and 12 percent by Lima production). The correlation between estimated and the observed price relatives (see section F, fig. 14) was 0.90 ($\bar{R}$ = 0.85).

19/ The equation of the regression line is $X_1^1 = 190.9 - 0.859\ (\pm\ 0.334)\ X_2$.

20/ The equations are $X_1^{11} = 36.6 - 0.338\ (\pm\ 0.140)\ X_4$ and $X_1^{111} = 36.2 - 0.322\ (\pm\ 0.160)\ X_5$ where X_4 = link relatives of production of colored beans, excluding Pink, and X_5 = link relatives of production of Lima beans.

FACTORS AFFECTING CALIFORNIA F. O. B. PRICE OF PINK BEANS, 1922-23 TO 1934-35

(PREVIOUS YEAR=100)



YEAR BEGINNING SEPTEMBER

[4] EXCLUDING PINK BEANS

[†] CORRECTED FOR INCOME OF INDUSTRIAL WORKERS, AND PRODUCTION OF COLORED AND OF LIMA BEANS

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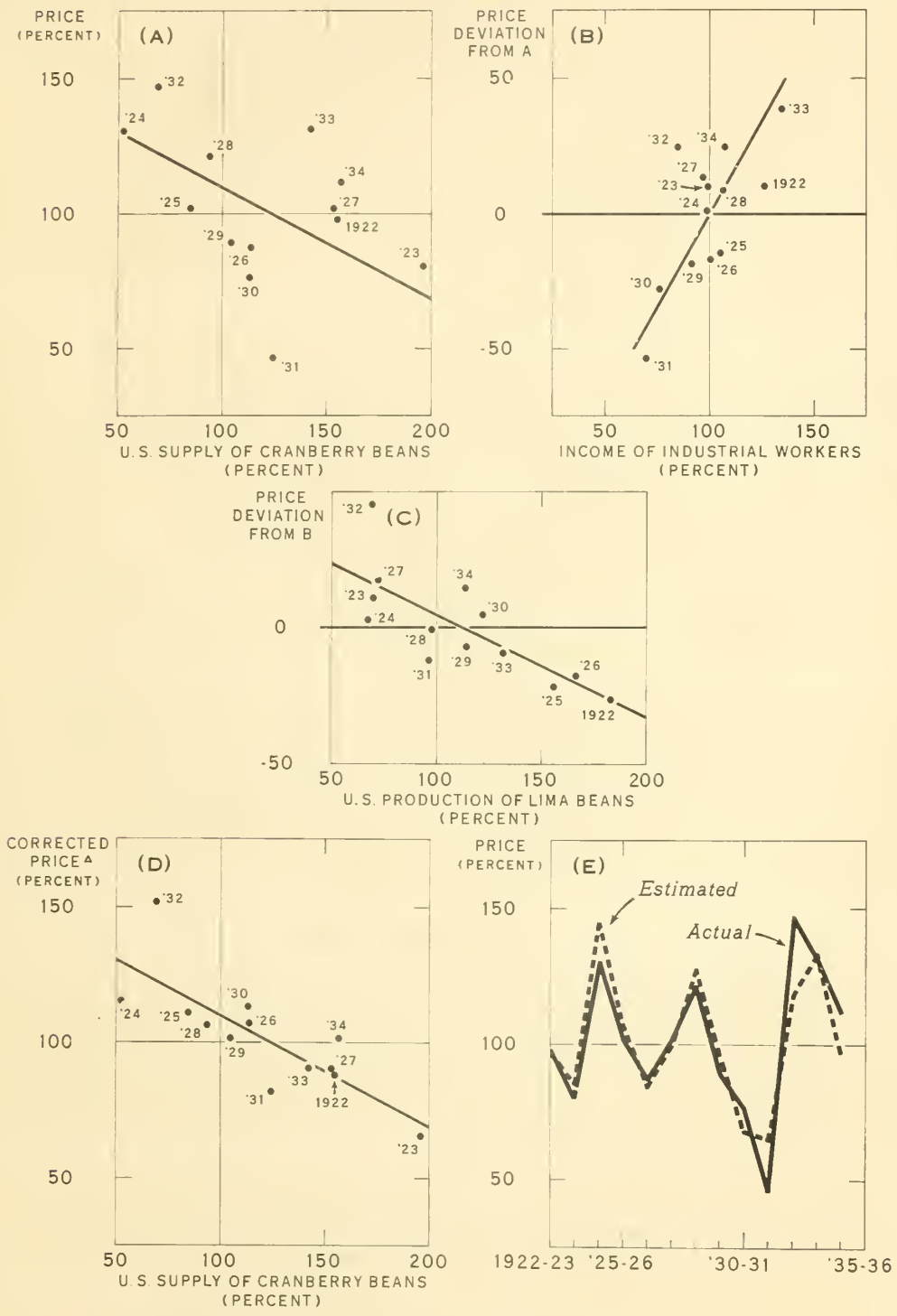
FIGURE 14

FACTORS AFFECTING CALIFORNIA F. O. B. PRICE OF CRANBERRY BEANS, 1922-23 TO 1934-35*

(PREVIOUS YEAR=100)



* *YEAR BEGINNING SEPTEMBER*

△ *CORRECTED FOR INCOME OF INDUSTRIAL WORKERS, AND PRODUCTION OF LIMA BEANS*

U. S. DEPARTMENT OF AGRICULTURE NEG. 31181 BUREAU OF AGRICULTURAL ECONOMICS

FIGURE 15

Cranberry Beans

The Cranberry bean, one of the less important of the colored varieties, and forming only about 1 percent of total bean production has been grown on a commercial basis chiefly in California, although the principal consumers appear to be among eastern miners. 21/ A supply figure including California stocks as well as production and an f.o.b. price were therefore available and were used in the analysis presented in figure 15. Link relatives of supply, income, and production of Lima beans are shown as influencing the Cranberry-price relatives. A change of 10 units in the link relatives of each of these factors was associated on the average with changes of 4.0, 13.7, and 3.8 units respectively, in the link relatives of price. 22/

There was some evidence that a change in the link relatives of the production of White beans of 10 units was associated with a change in Cranberry-price relatives of about 3 units, but this slope was less than twice its standard error. The relationship between price and production of colored varieties other than Cranberry likewise could not be determined reliably, but it seems probable that in those years when the crops of colored beans appreciably decline, the price of Cranberry beans would tend to be raised thereby. Strangely enough, from graphic evidence it appeared that foreign production of beans had rather more effect on the price of the Cranberry than on other varieties; that such a relationship is real rather than accidental seems dubious, however.

Industrial income was again the most important of the three considered factors in explaining variations in Cranberry prices, with supply of Cranberry beans next and production of Lima beans last, the coefficients of determination being 0.43, 0.25 and 0.11, respectively. The corresponding partial correlation coefficients were 0.86, -0.79 and -0.73. The correlation between the observed and estimated price relatives which are plotted in section E of figure 15 is 0.89 ($R = 0.85$).

Red Kidney Beans

The crop of Red Kidney beans is comparable to that of the Pink in size, and has tended on the whole to decline in relative importance during the period under consideration. It comprises about 5 percent of the total bean crop, and is grown largely in New York and Michigan. Production figures, and a New York wholesale price series, expressed as link relatives, have therefore been used in this analysis.

21/ During recent years Michigan has been growing increasing quantities which are reported to have been sent largely to the West Virginia market. See (3).

22/ The equations to the curves shown in figure 15 are as follows:

Sections A and D $X_1^{I} = 151.0 - 0.409\ (\pm 0.106)\ X_2$

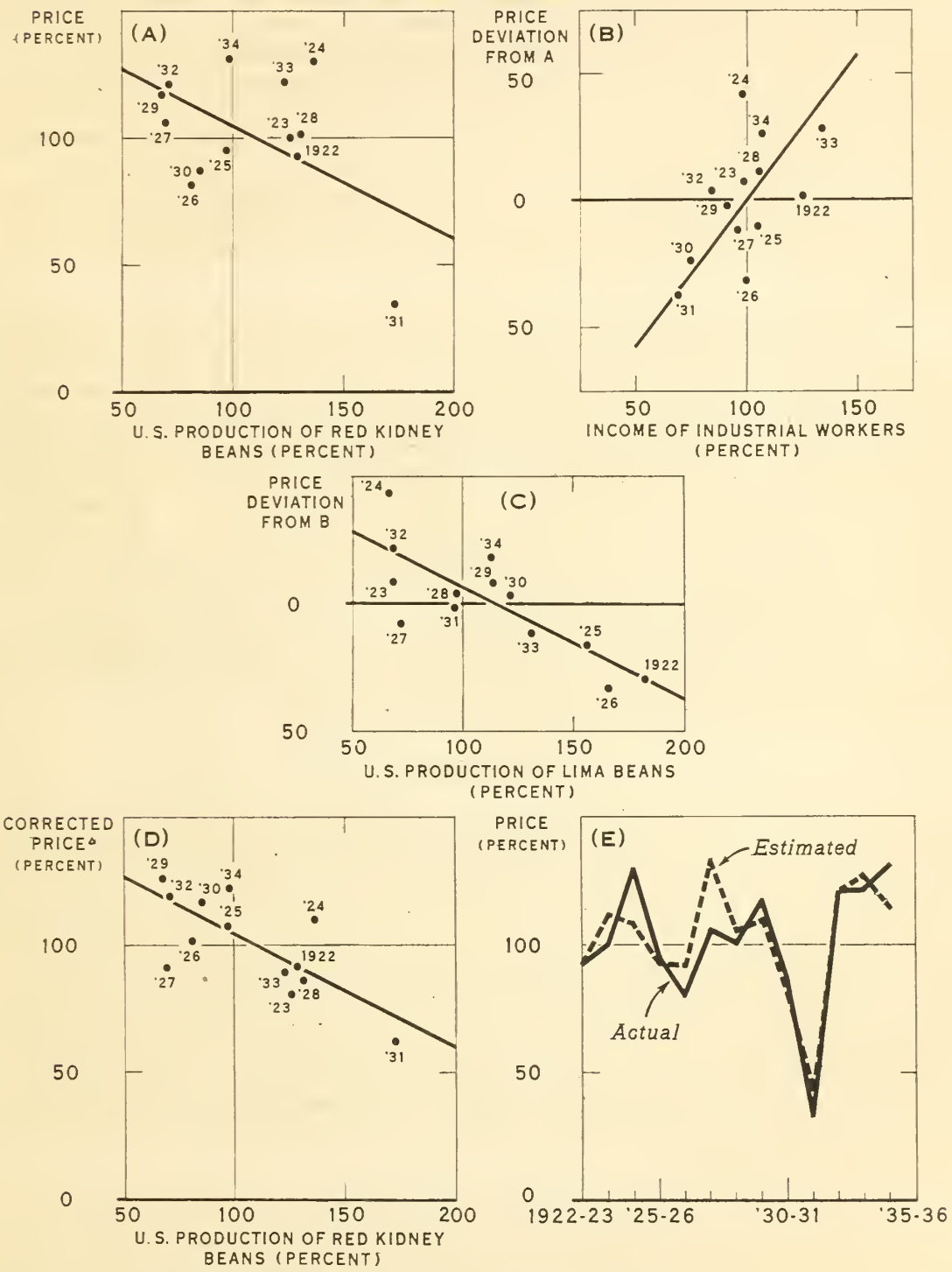
Section B $X_1^{II} = -136.2 + 1.366\ (\pm 0.268)\ X_3$

Section C $X_1^{III} = 42.6 - 0.380\ (\pm 0.119)\ X_4$

Where X_1 = price, X_2 = supply of Cranberry beans, X_3 = income of industrial workers, and X_4 = production of Lima beans, all in link relative units.

FACTORS AFFECTING NEW YORK WHOLESALE PRICE OF RED KIDNEY BEANS, 1922-23 TO 1934-35

(PREVIOUS YEAR=100)



YEAR BEGINNING SEPTEMBER

△ CORRECTED FOR INCOME OF INDUSTRIAL WORKERS AND PRODUCTION OF LIMA BEANS

U. S. DEPARTMENT OF AGRICULTURE NEG. 31182 BUREAU OF AGRICULTURAL ECONOMICS

FIGURE 16

Production of the Red Kidney and of Lima beans, and the income of industrial workers appear to be the most significant factors accounting for price variation. But they do not explain the price fluctuations as completely as the factors influencing the varieties studied heretofore, as may be seen from the final scatter shown in section D of figure 16, and in the series of estimated and actual price relatives plotted in section E, between which a correlation of 0.87 exists ($\bar{R} = 0.82$). No definite relationship between relatives of production of other colored or of white varieties, and Red Kidney price relatives could be established. There was greater evidence that meat as a substitute commodity, as measured by cattle inspected for slaughter, influenced the price of Red Kidney beans, but since the slope of the net regression line was less than twice its standard error this factor was not included in the final analysis.

The net regression line of the price of Red Kidney on production relatives has a slope of -0.44 ($\pm$ 0.13) indicating that an increase of 10 units in the production relative was associated during the period with a decrease of 4.4 units in the price relative. The price would thus seem to be relatively inflexible with respect to Red Kidney production for it responded by only 0.47 percent to a 1 percent change in production at the average. The equation (section B) shows that a 10-unit increase in the income relatives raised the price relatives by 11.6 units. Finally, in section C may be seen the relationship between Red Kidney price and Lima production relatives; an increase of 10 units in the latter being associated with a decrease of 4.2 units in the price relatives. The final residuals as shown in sections D and E are not only somewhat larger than the residuals for the other classes of beans, but also fluctuate rather differently prior to 1930-31 (see fig. 20).

Lima Beans

The Lima bean crop of the United States is comparable in size at present to those of the Great Northern and the Pinto. The Standard Lima still forms the largest element in the total Lima crop, but the Baby Lima has been gaining in importance. These two Lima types have been studied separately, although there appears to be an intimate relationship between them, the production of each having a significant influence on the price of the other. As may be seen in figure 9, the fluctuations in their prices are usually quite similar; and the California f.o.b. prices of Standard Lima beans differ from the New York wholesale prices only by a more or less constant differential. The California prices were used, and the California warehouse stocks were added to production to form supply series, for the entire commercial crops of both the Standard and the Baby Lima come from California.

The factors retained as showing evidence of having a measurable influence on the price relatives of both the Standard and Baby Lima were the link relatives of income of industrial workers, and the link relatives of the supplies of Standard and of Baby Lima beans; those factors discarded as not having met the tests of significance in the correlation analysis were the production relatives of colored and of white beans, and the relatives of cattle inspections.

As might be expected from the comparative sizes of the Standard and Baby Lima crops, the supply of the Standard variety is a more important factor influencing the price of the Baby Lima, than is the Baby Lima supply as a Standard Lima price factor. In fact, this latter relationship, as measured, is just on the margin of significance, for the slope of the net regression line of Standard Lima price relatives on Baby Lima supply relatives is -0.223 which is almost but not quite twice its standard error of 0.115. (See section C, fig. 17.) The direct contribution of this factor to price variance is only 7 percent. The partial correlation coefficient between Standard price relatives and Baby supply relatives is -0.54.

The supply of Standard Lima beans, on the other hand, was even more important in explaining the price of Standard Lima beans during the considered period that was industrial income, for the direct contributions of these two factors were 0.61 percent by Standard supply and 0.42 percent by industrial income. An increase of 10 units in the supply relatives tended to decrease the price relative by 6.7 units (see section A, fig. 17) 23/; the price of Standard Lima beans was therefore comparatively flexible with respect to supply. An increase of 10 units in the income relatives tended to increase the price relatives by 11.7 units. (See section B, fig. 11.) 24/

As before, the extent to which these three variables explained Standard Lima price variations for these years may be seen graphically in sections D and E of figure 17. The multiple-correlation coefficient is 0.915 ($\bar{R}$ = 0.885), while the three partial correlation coefficients are -0.88 (price and Standard Lima supply), 0.84 (price and income) and -0.54 (price and Baby Lima supply).

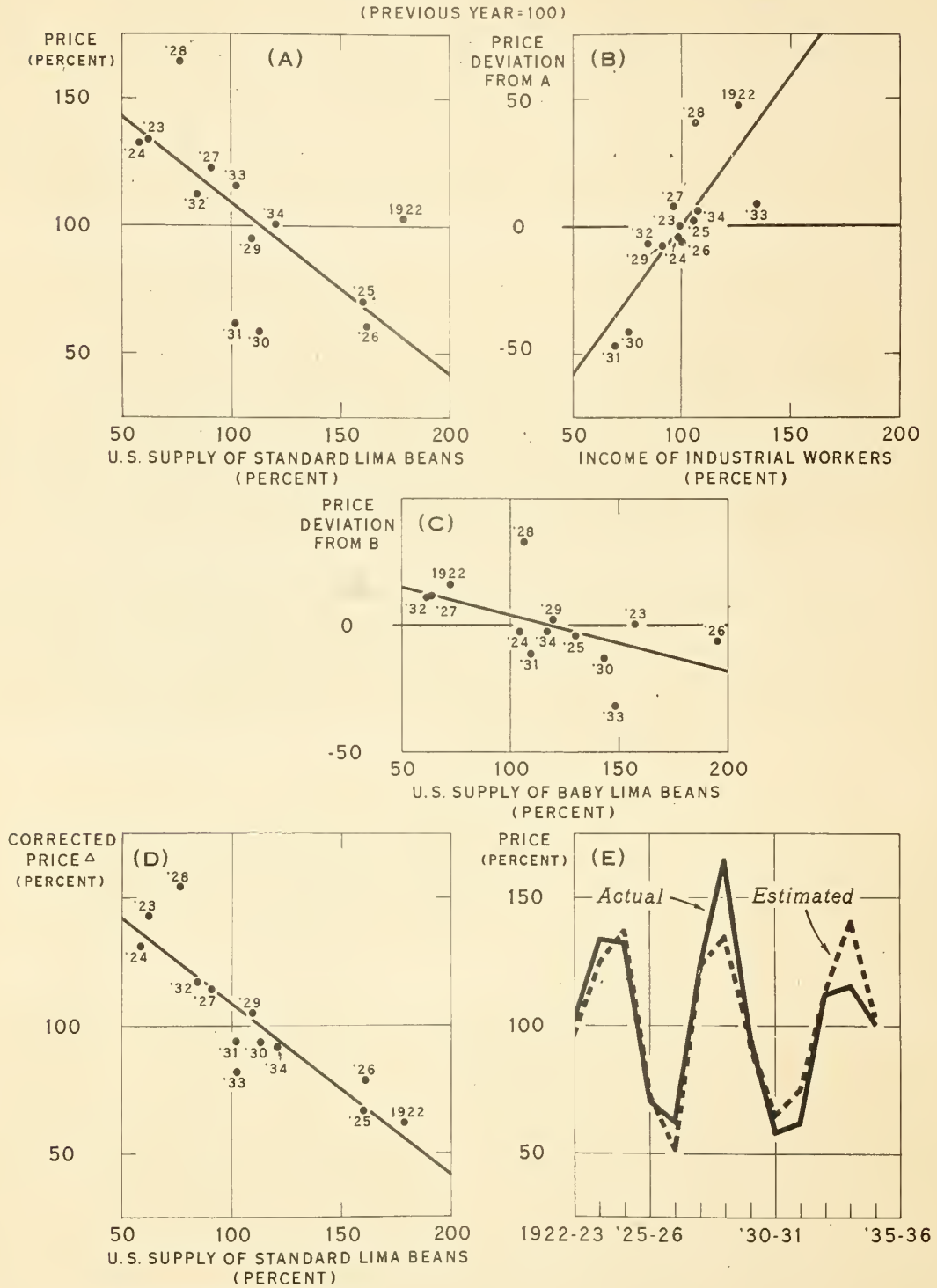
In the case of Baby Lima beans, supply was likewise found to be a more important factor explaining price variations than industrial income, though both income and Standard Lima supply also appeared definitely significant. The direct contributions of these three independent variables toward Standard Lima price variations were, in the order named above, 0.49, 0.26, and 0.16 percent. The corresponding partial correlation coefficients were -0.86, 0.76, and -0.68.

The slope of the regression line shown in section A, figure 18, is -0.631 (± 0.126) indicating that a 10-unit increase in the relatives of Baby Lima supply was associated with a decrease of 6.3 units in the price relatives. The values of the slopes in sections B and C are 0.989 (± 0.283) and -0.372 (± 0.135), measuring changes in price relatives with changes in income relatives and Standard Lima supply relatives respectively. This was the only case in which the slope of the regression of the price of a variety of dry beans on industrial income was found to be numerically less than unity. Changes in price of this variety, on the other hand, were relatively responsive to changes in the supply, though not quite so much so as was true of the Pink bean (see p. 29).

23/ The equation to the regression line is $X_1^1 = 175.8 - 0.669\ (\pm\ 0.123)\ X_2$ when X_1 = link relatives of Standard Limaprice and X_2 = link relatives of Standard Lima supply.

24/ The equation is $X_1^{11} = -117.3 + 1.176\ (\pm\ 0.257)$ where X_3 = link relatives of the income of industrial workers.

FACTORS AFFECTING CALIFORNIA F. O. B. PRICE OF STANDARD LIMA BEANS, 1922-23 TO 1934-35



YEAR BEGINNING SEPTEMBER

△ CORRECTED FOR INCOME OF INDUSTRIAL WORKERS, AND SUPPLY OF BABY LIMA BEANS

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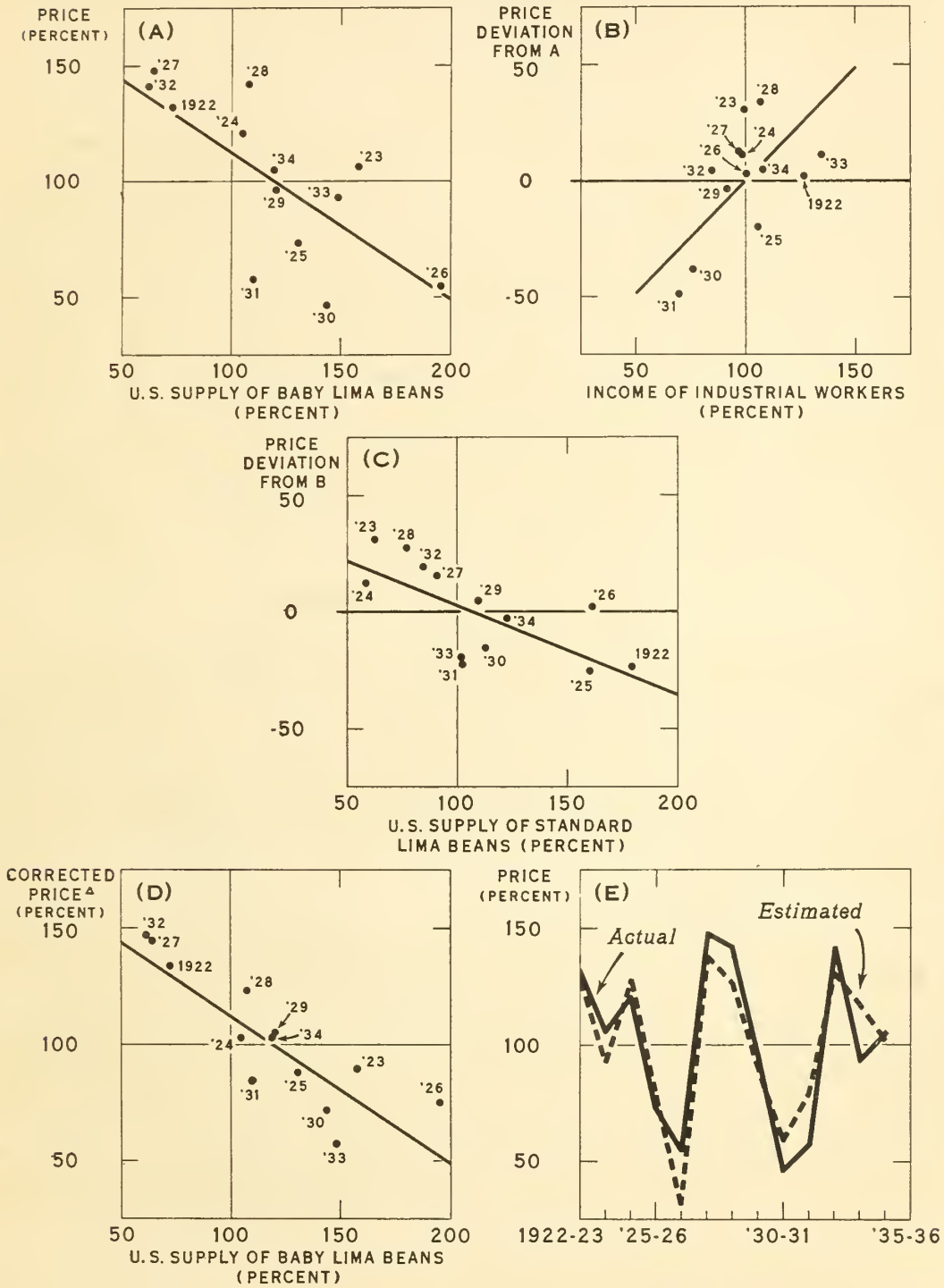
FIGURE 17

FACTORS AFFECTING CALIFORNIA F. O. B. PRICE OF BABY LIMA BEANS, 1922-23 TO 1934-35

(PREVIOUS YEAR=100)



YEAR BEGINNING SEPTEMBER

△ CORRECTED FOR INCOME OF INDUSTRIAL WORKERS, AND SUPPLY OF STANDARD LIMA BEANS

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FIGURE 18

The last two sections of figure 18 show graphically the extent to which price variations were explained by the use of the calculated equation. The correlation between the actual and estimated price relative was 0.911 ($\bar{R}$ = 0.879).

Total Beans

Before making a comparison of the final residuals obtained in the preceding studies of the more important varieties of beans, it may be noted that some attention was given to variations in the link relatives of the price of all beans. The price chosen for this purpose was the United States average farm price. The fluctuations in this price (fig.10) follow most closely those in Pea-bean prices, which is to be expected, since the total average farm price is most heavily weighted by this variety. The quantity series used was total production of dry edible beans. Both production and income relatives were found to be significant factors, the latter being the more important. An increase of 10 units in these variables tended to decrease and increase price relatives by 6.0 and 14.9 units respectively. The corresponding partial correlation coefficients were -0.68 and 0.93. The correlation between the price relatives estimated from these two variables and those observed was found to be 0.93 ($\bar{R}$ = 0.92). The results are shown in figure 19. 25/

COMPARISON OF FINAL RESIDUALS

The differences between the actual price relatives and those estimated from the various equations described above have been plotted as a number of time series, one above another, to facilitate comparisons (fig. 20). In each case the fluctuating line represents the differences between the observed price relative and the estimated price relative, which is the zero line. The dotted extensions for the years 1935-36 and 1936-37, 26/ provide a test as to the workability of the results as forecasting devices.

Fairly satisfactory forecasts were made in both years for only three varieties, Pink, Standard Lima and Baby Lima; for years of average conditions for two varieties (Pinto and Pea beans), but not in the years when extraordinary changes in the size of the crop occurred giving observations far beyond the range of previous experience. In 1936 the Pea-bean production was only 52 percent of the large 1935 crop. This decline was greater than any other that occurred in the period analyzed, and, as was explained above (p. 26), a straight line may be a poor approximation at the extremes of the observational range or beyond them. A much greater price rise occurred in Pea beans than had been estimated for 1936-37; part of the rise was therefore probably due to this fact.

25/ The equations to the two regression lines are:

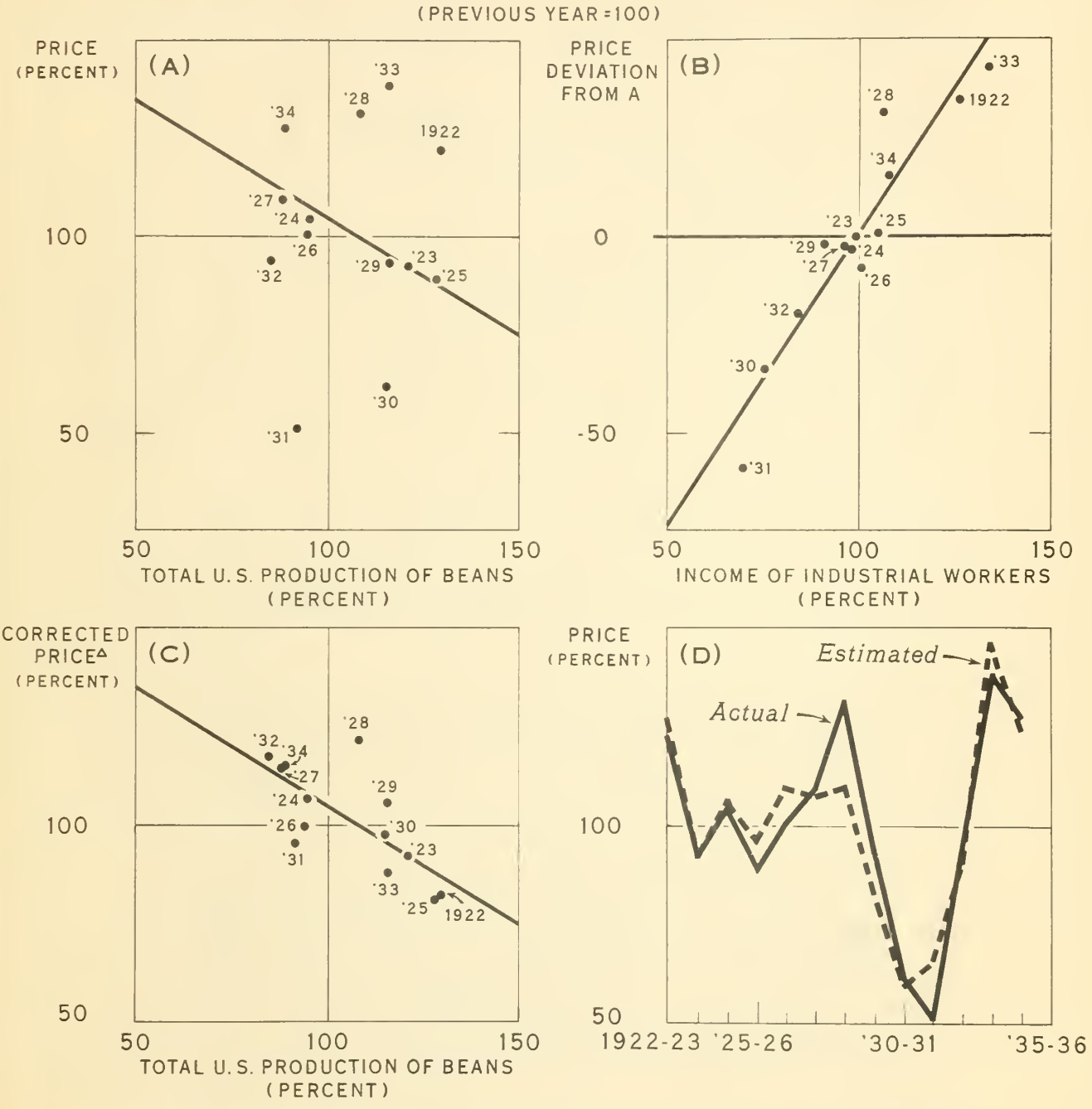
$$X_1^{I} = 164.8 - 0.598\ (\pm\ 0.204)\ X_2$$

$$X_1^{II} = -148.3 + 1.486\ (\pm\ 0.183)\ X_3$$

Where X_2 is total production of dry edible beans, and X_3 is income of industrial workers, in terms of link relatives.

26/ Preliminary data for 1936-37.

FACTORS AFFECTING UNITED STATES AVERAGE FARM PRICE OF BEANS, 1922-23 TO 1934-35



YEAR BEGINNING SEPTEMBER

△CORRECTED FOR INCOME OF INDUSTRIAL WORKERS

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FIGURE 19

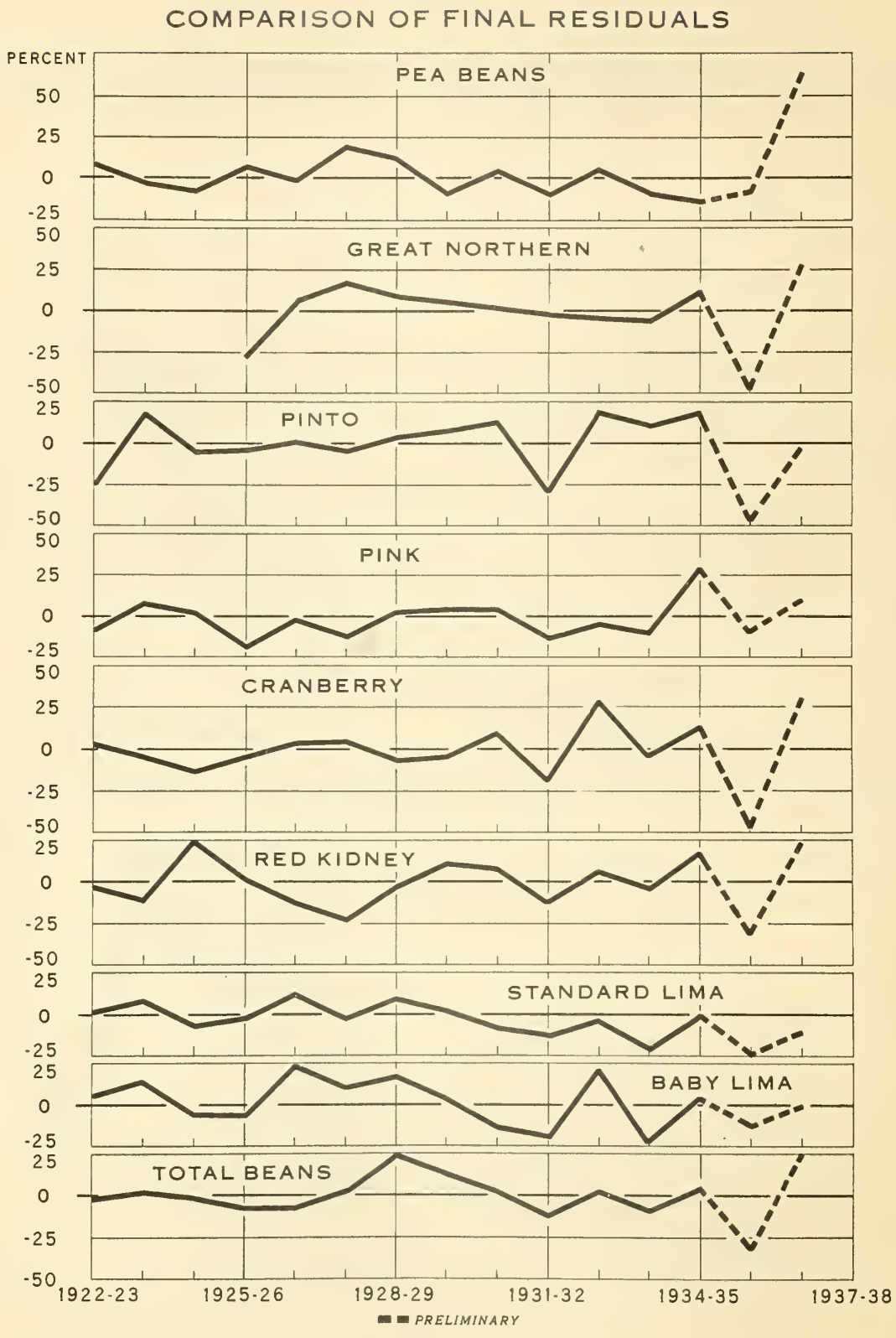
COMPARISON OF FINAL RESIDUALS
PERCENT
PEA BEANS
GREAT NORTHERN
PINTO
PINK
CRANBERRY
RED KIDNEY
STANDARD LIMA
BABY LIMA
TOTAL BEANS
50
25
0
-25
-50
1922-23
1925-26
1928-29
1931-32
1934-35
1937-38
PRELIMINARY
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FIGURE 20

In the case of Pinto beans, on the other hand, the production relative in 1935 was larger than in any other year of the period; an above-average crop in 1935 followed the exceptionally small one of 1934 which had been cut by the drought. Although in the case of Pinto beans a linear relationship was not used, the extrapolation gave a large negative deviation of the observed from the estimated price relative in that year.

In two cases (Red Kidney and total beans) the deviations were large but no so much so as to cast complete doubt on the adequacy of the equations; in the remaining two (Great Northern and Cranberry beans), however, the deviations in both years were so large as to offer a distinct warning against the use of these equations for estimating purposes. In the case of Cranberry beans, an explanation lies, perhaps, in the fact that new conditions may have arisen with the distinct shift in the producing area from California to Michigan which have upset the previous price-quantity relationships as measured by these particular series. As for the Great Northern, the attempt to determine the demand curve under the conditions of rapid change for this variety (see p.23) must be judged unsuccessful; the need for further analysis or a wait for additional observations is clearly indicated.

In comparing the fluctuations in the nine series it is evident that there are certain features common to all or most of the deviations in certain years. In 1931-32 and in 1935-36 the actual price relative was below the estimated in all nine cases, and below in eight of them in 1933-34; in 1936-37 the observed was above the estimated in eight of the series, and in seven of them during the years 1928-29 through 1930-31.

That all factors - or even all the important ones - that influence the price of beans have been considered in these studies is not, of course, assumed. For instance, the quality of the crop is not readily measurable; complete carry-over figures, imports, and foreign production by classes are not available; and competition offered by other foods has not been completely studied. In particular years, any or all of these factors may exert definite pressures on the price of beans.

In 1931-32, for example, the opening carry-over appears to have been unusually large, whereas in the period 1928-30, stocks were small. A large carry-over in 1925-26 may explain at least partially the minus deviations in that year. As regards the effect of carry-over on price, it may be interesting to note here that all the evidence available seems to indicate that a given absolute change in the size of the carry-over will have a greater price effect when the total carry-over is small than when it is large.

No attempt has been made to measure the effects of the tariff on the prices of the different classes of beans, although two changes in the duty took place during the period under consideration. In September 1922 the rate was reduced from 2 cents per pound to 1.75 cents and in June 1930 it was raised to 3 cents per pound (see p. 4 and fig. 4). The last change especially may have been a disturbing factor, but how much the price of any particular class may have been raised cannot be said.

SUMMARY

The results of this study on the factors influencing the prices of different varieties of beans are summarized in table 9. Changes in income of industrial workers, as indicated both by the small standard errors of the regression coefficients and the coefficients of determination, was clearly the most important of the considered factors during the period 1922-23 to 1934-35. Changes in the quantity of each variety (that is, production or production plus stocks when they were known) were found to be of less, though still of some, significance as an influence on the changes in price of that variety. Only in the case of Standard and Baby Lima beans did changes in supply account for more rather than less of the price fluctuations than did changes in income. Concerning the rest of the discovered relationships, however, it is impossible to generalize, as may readily be observed from table 9.

Some idea as to the responsiveness of price to changes in these factors may be obtained by comparing the values of the different slopes. In general, prices were more flexible with respect to income than with respect to the production series. That is, a 1-percent change in income was accompanied by a more than 1-percent change in price, but a 1-percent change in the production or supply of the different kinds of beans brought about a change in price of less than 1 percent. The only exception was the Baby Lima, the price of which responded by slightly less than 1 percent to a 1-percent change in income. As might be expected, the price of a variety was usually less flexible with respect to changes in other varieties than to changes in its own production.

Although the correlations between the actual price relatives and those estimated from the described factors have been high, in nearly every case the multiple-correlation coefficient being greater than 0.9, it is not assumed that all important influences have been accounted for. In particular, certain elements in the supplies of beans, complete carry-over figures, imports and exports by classes, and the varying qualities of the crops were not considered quantitatively, because of the lack of data. In addition to the competition existing between the different varieties of beans, they probably meet with some competition from other foods, particularly meat, although such relationships have not been definitely determined.

As judged by the success or failure in estimating prices for two additional years for which preliminary data have become available, five of the equations appear to be fairly satisfactory for forecasting under conditions of normal changes. They appear to be of doubtful validity in two cases (Red Kidney and total) and to be distinctly failures in the case of the Great Northern and Cranberry beans.

Table 1.-Production of dry edible beans in the United States, by commercial classes, 1921-22 to 1936-37

Class of bean	Year beginning Sept. 1921-22	1922-23	1923-24	1924-25	1925-26	1926-27	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36
	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/	1,000 bags 1/
White															
Pea and Medium:															
White	2,281	3,233	4,130	4,121	4,944	4,318	5,031	3,358	5,546	3,141	3,856	5,403	4,391	4,396	5,903
Great Northern	---	29	165	594	739	922	1,208	1,387	1,747	2,011	1,956	992	1,440	1,084	1,441
California															
Small White	120	325	360	77	200	180	280	424	415	489	429	226	417	402	351
White Marrow	103	82	91	176	198	63	81	103	135	180	201	101	123	139	154
White Kidney	51	63	71	78	51	63	49	29	42	41	111	58	80	142	109
Total White	2,555	3,732	4,807	5,046	6,132	5,546	4,649	5,301	5,685	5,862	6,553	6,780	6,456	6,163	7,058
Colored															
Red Kidney 2/	395	510	645	881	862	698	490	642	442	376	651	465	573	563	631
Small Red	120	75	60	73	163	113	220	282	393	520	474	250	279	267	292
Cranberry	40	75	143	70	60	73	110	106	113	128	159	94	151	242	113
Pink	560	661	670	282	653	599	553	575	619	625	436	516	595	485	843
Yellow Eye	103	118	132	171	106	96	109	95	100	81	137	78	105	174	146
Pinto	742	352	1,079	1,034	1,597	1,287	1,597	1,402	2,319	3,096	1,687	859	1,828	579	2,147
Black Eye	380	250	275	277	450	450	300	428	514	852	459	275	587	525	615
Total Colored	2,340	2,041	3,004	2,738	3,891	3,316	3,379	3,530	4,500	5,678	4,003	2,537	4,118	2,835	5,087
Lima															
Standard Lima	675	1,368	850	480	300	1,250	1,010	890	987	1,102	1,064	872	943	1,072	989
Baby Lima	150	140	220	225	300	580	310	401	486	696	663	322	630	708	536
Total Lima	825	1,508	1,070	705	1,100	1,830	1,320	1,291	1,473	1,798	1,727	1,194	1,573	1,780	1,525
Other and seed	365	620	786	560	586	332	389	452	620	795	631	494	624	615	653
Grand total	6,085	7,901	9,587	9,099	11,709	11,024	9,737	10,574	12,278	14,133	12,914	11,005	12,771	11,393	14,323

1/ Bags of 100 pounds.
2/ Red Kidney includes Dark Red Kidney.

Table 2.-Percentage production of dry edible beans in the United States, by commercial classes, 1921-22 to 1936-37

Class of bean	Year beginning Sept. 1921-22	1922-23	1923-24	1924-25	1925-26	1926-27	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
White																
Pea and Medium White	37.49	40.92	42.97	45.29	42.22	39.17	31.13	31.76	27.25	22.22	29.86	49.10	34.38	38.59	34.93	23.28
Great Northern	---	.37	1.72	6.53	6.31	8.37	12.41	13.12	14.23	14.23	15.15	9.01	11.28	9.51	10.06	12.47
California																
Small White	1.97	4.11	3.76	.85	1.71	1.63	2.88	4.01	3.38	3.46	3.32	2.05	3.27	3.53	2.45	4.51
White Marrow	1.69	1.04	.95	1.93	1.69	.57	.83	.97	1.10	1.27	1.56	.92	1.00	1.22	1.08	1.12
White Kidney	.84	.80	.74	.86	.44	.57	.50	.27	.34	.29	.86	.53	.63	1.25	.76	.39
Total White	41.99	47.24	50.14	55.46	52.37	50.31	47.75	50.13	46.30	41.77	50.75	61.61	50.56	54.10	49.28	41.77
Colored																
Red Kidney 1/	6.49	6.45	6.73	9.68	7.36	6.33	5.03	6.07	3.60	2.66	5.04	4.22	4.49	4.94	4.41	6.07
Small Red	1.97	.95	.63	.80	1.39	1.03	2.26	2.67	3.20	3.68	3.67	2.27	2.18	2.34	2.04	1.71
Cranberry	.66	.95	1.49	.77	.51	.66	1.13	1.00	.92	.91	1.23	.85	1.18	2.12	2.88	2.00
Pink	9.20	8.37	6.99	3.10	5.58	5.43	5.68	5.44	5.04	4.42	3.38	4.69	4.66	4.26	5.89	4.02
Yellow Eye	1.69	1.49	1.38	1.88	.91	.87	1.12	.90	.81	.57	1.06	.71	.82	1.53	1.02	.90
Pinto	12.19	4.46	11.25	11.37	13.64	11.68	16.40	13.26	18.89	21.91	13.06	7.81	14.31	5.08	14.99	14.01
Black Eye	6.25	3.16	2.87	3.04	3.84	4.08	3.03	4.05	4.19	6.03	3.55	2.50	4.60	4.61	4.29	6.88
Total Colored	38.45	25.83	31.34	30.64	33.23	30.08	34.70	33.39	36.65	40.18	30.99	23.05	32.24	24.88	35.52	35.59
Lima																
Standard Lima	11.09	17.31	8.66	5.28	6.83	11.34	10.37	8.42	8.04	7.80	8.24	7.92	7.38	9.41	6.90	10.06
Baby Lima	2.47	1.77	2.29	2.47	2.56	5.26	3.19	3.79	3.96	4.92	5.13	2.93	4.93	6.21	3.74	7.88
Total Lima	13.56	19.08	10.95	7.75	9.39	16.60	13.56	12.21	12.00	12.72	13.37	10.85	12.31	15.62	10.64	17.94
Other and seed	6.00	7.85	7.57	6.15	5.01	3.01	3.99	4.27	5.05	5.63	4.89	4.49	4.89	5.40	4.56	4.70
Grand total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Computed from data in table 1. 1/ Red Kidney includes Dark Red Kidney.

Table 3.-Production and percentage of total dry edible beans produced in the United States, by commercial classes and leading States, average 1924-25 to 1933-34

State	Pea & Medium White	Great Northern	Calif. Small White	White Marrow	White Kidney	Red Kidney 1/	Small Red	Cranberry	Pink	Yellow Eye	Pinto	Black Eye	Standard Lima	Baby Lima	Other and seed	Total
	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/
Me.	8	---	---	3	4	9	---	---	---	26	---	---	---	---	7	57
Vt.	4	---	---	2	1	1	---	---	---	10	---	---	---	---	4	22
N. Y.	328	---	---	132	56	228	---	---	---	72	---	---	---	---	21	837
Mich.	3,511	---	---	---	---	317	---	10	---	---	---	---	---	---	98	3,936
Wis.	32	---	---	---	---	---	---	---	---	---	---	---	---	---	3	35
Minn.	33	---	---	---	---	---	---	---	---	---	---	---	---	---	---	33
Nebr.	---	29	---	---	---	---	---	---	---	---	13	---	---	---	6	48
Mont.	5	273	---	---	---	---	---	---	---	---	---	---	---	---	21	299
Idaho	62	782	---	---	---	---	201	---	---	---	---	---	---	---	190	1,235
Wyo.	---	188	---	---	---	---	---	---	---	---	10	---	---	---	31	229
Colo.	1	18	---	---	---	---	---	---	---	---	1,060	---	---	---	47	1,126
N. Mex.	---	---	---	---	---	---	---	---	7	---	516	---	---	---	14	537
Ariz.	---	---	---	---	---	---	---	---	14	---	16	---	---	---	5	35
Calif.	---	---	314	---	---	53	75	96	525	---	28	459	940	461	111	3,062
Other	6	---	---	---	---	---	---	---	---	---	28	---	---	---	---	34
Total U.S.	3,990	1,300	314	137	61	608	276	106	546	108	1,671	459	940	461	548	11,525
	Percentage of total															
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Me.	.20	---	---	2.19	6.56	1.48	---	---	---	24.07	---	---	---	---	1.28	.49
Vt.	.10	---	---	1.46	1.64	.16	---	---	---	9.26	---	---	---	---	.73	.19
N. Y.	8.22	---	---	96.35	91.80	37.50	---	---	---	66.67	---	---	---	---	3.83	7.26
Mich.	87.99	---	---	---	---	52.14	---	9.43	---	---	---	---	---	---	17.88	34.15
Wis.	.80	---	---	---	---	---	---	---	---	---	---	---	---	---	.55	.30
Minn.	.83	---	---	---	---	---	---	---	---	---	---	---	---	---	---	.29
Nebr.	---	2.23	---	---	---	---	---	---	---	---	.78	---	---	---	1.09	.42
Mont.	.13	21.00	---	---	---	---	---	---	---	---	---	---	---	---	3.83	2.59
Idaho	1.55	60.92	---	---	---	---	72.83	---	---	---	---	---	---	---	32.85	10.72
Wyo.	---	14.46	---	---	---	---	---	---	---	---	.60	---	---	---	5.66	1.99
Colo.	.03	1.39	---	---	---	---	---	---	---	---	63.43	---	---	---	8.58	9.77
N. Mex.	---	---	---	---	---	---	---	---	1.28	---	30.88	---	---	---	2.55	4.66
Ariz.	---	---	---	---	---	---	---	---	2.57	---	.96	---	---	---	.91	.30
Calif.	---	---	100.0	---	---	8.72	27.17	90.57	96.15	---	1.68	100.0	100.0	100.0	20.26	26.57
Other	.15	---	---	---	---	---	---	---	---	---	1.67	---	---	---	---	.30
Total U.S.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Includes Dark Red Kidney. 2/ Bags of 100 pounds.

Table 4.-Foreign trade in dry edible beans, of the United States, by countries, 1921-22 to 1935-36

Foreign trade and country	Year beginning Sept. 1921-22 1/	1922-23	1923-24	1924-25	1925-26	1926-27	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36
Imports:	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/
Europe-															
Austria	---	4	---	2	11	6	11	1	13	3/	---	---	---	---	---
Belgium	38	56	---	18	29	67	202	22	22	10	---	---	---	---	3/
Czechoslovakia	---	---	---	9	1	4	9	1	4	1	---	---	---	---	---
France	292	357	56	85	124	166	201	16	45	36	3	1	3/	3/	3/
Germany	15	8	1	25	55	41	127	22	94	21	3/	---	3/	---	3/
Italy	26	36	39	106	152	152	62	22	74	37	6	8	3	2	1
Netherlands	24	33	9	22	28	23	35	14	23	11	5	3	3	3	2
Poland and Danzig	---	---	---	1	1	6	7	---	10	4	3/	---	---	---	---
Hungary	3	29	---	8	4	13	26	1	102	17	---	---	---	---	3/
Rumania	---	5	1	4	5	---	1	4	15	3	---	---	---	---	1
United Kingdom	11	105	61	52	4	2	29	41	66	1	3/	---	3/	3/	3/
Total	409	633	187	332	414	480	710	144	468	141	14	12	6	4/ 6	4/ 6
Asia-															
Japan	98	541	264	339	210	231	383	290	601	481	23	13	22	84	12
Hong Kong	15	20	18	20	24	23	20	23	23	22	28	21	31	32	32
China	3	6	3	7	6	8	7	11	8	5	1	3/	1	3	6
Kwantung	---	2	---	1	---	1	2	---	2	---	3	3	---	1	---
Total	116	569	285	367	240	253	412	324	634	508	55	37	54	120	4/ 51
North America-															
Canada	8	62	9	21	36	8	38	25	128	9	1	2	3/	3/	5
Mexico	19	60	7	11	5	8	65	41	5/ 18	5/ 14	5/ 17	17	73	152	6
Dominican Republic	2	3/	3/	---	---	2	4	10	20	12	3/	---	3/	3/	3/
Cuba	4	1	3/	1	1	1	1	1	5/ 14	5/ 28	2	1	3/	3/	---
Total	33	123	16	33	42	19	158	77	180	63	20	20	73	152	11
South America-															
Chile	42	23	16	55	2	26	182	188	140	76	17	23	8	94	75
Argentina	3/	3/	1	15	6	2	11	6	7	11	6	8	14	12	9
Peru	---	---	---	1	---	---	1	9	2	3/	3	---	---	1	---
Total	42	23	17	71	8	28	194	203	149	87	26	31	22	107	84

Continued-

Table 4.-Foreign trade in dry edible beans, of the United States, by countries, 1921-22 to 1935-36-contd

Foreign trade and country	Year beginning Sept. 1921-22 1/	1922-23	1923-24	1924-25	1925-26	1926-27	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36
	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/	1,000 bags2/
Imports -contd.															
Africa-															
Madagascar	---	9	35	54	2	---	---	26	22	---	---	---	---	---	---
Other countries	3	3	25	7	10	16	9	8	12	4	1	2	3	5	3/
Total imports	603	1,360	545	864	716	796	1,483	782	1,465	803	116	102	158	389	152
Reexports	130	225	138	176	187	194	158	191	154	105	98	39 6/	44	48	114
Domestic exports:															
Cuba	7/	7/	324	224	219	248	177	97	78	39	29	30	22	15	47
Mexico	7/	7/	10	16	70	15	7	10	22	73	6	3	2	1	3
Nicaragua	7/	7/	12	8	10	14	11	7	7	18	11	6	6	3	1
Panama	7/	7/	6	7	7	9	8	7	9	11	9	11	7	8	9
Canada	7/	7/	8	7	9	14	14	12	14	3	7	3	7	8	6
Other countries	7/	7/	51	32	32	34	25	38	40	25	25	24	24	20	21
Total	607	393	411	294	347	334	242	171	170	174	87	79	68	55	87
Net imports (+) or net exports (-)	-124	742	-54	394	182	268	1,083	420	1,141	524	-69	-16 6/	79	334	65
Shipments to non-contiguous territories	8/169	8/155	8/197	8/205	276	245	275	283	189	225	328	407	333	271	357
Net movement	-293	587	-251	189	-94	23	808	137	952	299	-397	-423	-254	63	-292

Compiled from records of Bureau of Foreign and Domestic Commerce.

1/ Data by country of origin are approximations only.

2/ Bags of 100 pounds.

3/ Less than 500 bags.

4/ Includes small amounts from other European or Asian countries.

5/ Including imports of Blackeye beans which were reported separately after June 18, 1930, as follows: from Mexico, 2,000 bags in 1929-30, 1,000 bags in 1930-31 and 1,000 bags in 1931-32; from Cuba, 4,000 bags in 1929-30, 15,000 in 1930-31. Not reported since 1930-31.

6/ Imports for consumption beginning January 1, 1934. Reexports from September to December 31, 1933 were 11,000 bags; only these, therefore, and not the 33,000 bags reported from January 11 through August 31, 1934, were considered in obtaining the net figure.

7/ Data not available by countries.

8/ Approximations; beans not separately reported until 1925.

Table 5. - Production of dry edible beans in specified countries, 1921-22 to 1936-37 1/

Country	Year beginning September															
	1921-22	1922-23	1923-24	1924-25	1925-26	1926-27	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/
North America:																
United States	6,085	7,901	9,587	9,099	11,709	11,024	9,737	10,574	12,278	14,133	12,914	11,005	12,771	11,393	14,323	11,122
Canada	654	782	625	716	900	696	622	702	895	863	782	685	534	488	697	500
Mexico	1,566	2,539	2,617	1,952	4,136	4,398	4,187	3,883	2,094	1,820	2,997	2,907	4,097	2,729	2,450	---
Total	8,305	11,222	12,829	11,767	16,745	16,118	14,546	15,159	15,267	16,816	16,693	14,597	17,402	14,610	17,470	---
Europe:																
United Kingdom 3/	4,121	4,301	4,323	4,278	3,629	3,606	3,718	2,979	2,531	3,203	2,755	2,710	2,710	2,643	2,076	---
Netherlands	239	393	254	346	403	361	233	230	336	429	397	339	338	351	340	---
France	2,232	2,546	1,379	2,457	3,436	2,100	2,707	1,535	2,249	3,119	3,254	3,047	2,299	2,280	2,403	2,406
Italy	2,469	1,839	1,647	2,621	3,148	3,534	2,441	1,785	3,468	3,490	2,892	3,970	3,411	4,175	3,020	4,146
Spain	3,406	3,640	3,053	3,161	3,728	2,766	3,877	2,578	3,438	3,631	3,427	3,333	3,427	3,522	3,386	---
Germany	(400)	(400)	(400)	(400)	(400)	(400)	(400)	253	272	255	240	239	237	184	153	152
Poland	700	628	716	645	729	703	802	909	817	912	1,010	810	764	731	907	867
Czechoslovakia 4/	196	255	298	303	312	311	295	215	247	214	198	204	145	4/ 509	4/ 369	---
Austria	171	134	152	195	231	172	215	208	272	276	247	208	232	168	189	---
Greece	166	173	179	176	174	205	106	104	139	169	258	311	327	282	318	---
Danubian countries:																
Hungary	698	714	769	782	1,086	1,358	1,054	605	1,023	1,017	1,335	1,909	1,588	1,389	759	1,375
Yugoslavia	(1,500)	1,681	1,364	1,931	2,015	2,612	1,573	697	2,068	3,352	2,196	3,294	2,570	3,487	2,530	3,197
Rumania	2,239	3,541	5,143	6,877	6,547	5,542	3,784	2,600	5,711	4,476	7,284	7,142	7,290	5,207	6,184	4,850
Bulgaria	809	802	1,022	1,340	1,303	992	638	386	1,121	1,364	1,787	1,659	1,666	1,182	1,470	1,635
Total Danubian countries	5,246	6,738	8,298	10,930	10,952	10,504	7,049	4,288	9,923	10,209	12,602	14,004	13,114	11,265	10,943	11,057
Total Europe	19,346	21,047	20,699	25,512	27,142	24,662	21,843	15,084	23,692	25,907	27,110	29,175	27,004	26,110	24,104	
Asia:																
Japan 5/	1,476	1,622	1,427	1,197	1,841	1,382	1,617	1,423	2,156	2,919	1,519	1,078	2,444	1,707	1,338	1,552
Chosen	(115)	(115)	148	77	122	137	99	83	89	103	70	79	84	58	74	---
Total	1,591	1,737	1,575	1,274	1,963	1,519	1,716	1,506	2,245	3,022	1,589	1,157	2,528	1,765	1,412	
South America:																
Brazil	12,442	13,896	12,584	12,699	12,456	12,921	13,094	16,036	14,536	15,148	15,922	15,533	16,111	15,873	(15,500)	---
Chile	1,036	1,127	910	803	970	1,126	1,725	1,660	1,691	1,408	1,404	2,166	1,868	1,884	1,685	---
Total	13,478	15,023	13,494	13,502	13,426	14,047	14,819	17,696	16,227	16,556	17,326	17,699	17,979	17,757	(17,185)	
Africa:																
Egypt	7,814	7,231	7,127	5,886	6,776	5,480	7,107	6,643	7,827	6,247	6,032	9,855	7,165	6,035	6,454	6,596
Madagascar	331	419	278	275	150	305	281	362	282	247	337	351	463	470	471	---
Total	7,845	7,650	7,405	6,161	6,926	5,785	7,388	7,005	8,109	6,494	6,369	10,206	7,628	6,505	6,925	
Total all countries reporting	50,565	56,679	56,002	58,216	66,202	62,131	60,312	56,450	65,540	68,795	69,087	72,834	72,541	66,747	67,096	

Compiled from official sources and International Institute of Agriculture. Figures are for the harvesting seasons 1921 to 1935 in the Northern Hemisphere and 1921-22 to 1935-36 in the Southern Hemisphere. Figures in parentheses are interpolations in minor producing countries based on production in preceding or succeeding years.

1/ Excluding soy, mung, adzuki, broad, and horse beans and similar classes not commonly used as edible beans in the United States.
2/ Bags of 100 pounds.
3/ Includes North Ireland, Scotland, England, and Wales. These figures may include some feed beans.
4/ Grown alone through 1933-34; thereafter beans grown with other crops are included as follows: 1934-35, 352,890 bags; 1935-36, 260,921.
5/ Production in Hokkaido Province, where most of the dry edible bean varieties are grown.

Table 6.- Carry-over of dry edible beans in California, by commercial classes, 1921-36 1/

Year	Standard Lima	Baby Lima	Pink	Small White	Large White	Black-eye	Bayo	Cranberry	Calif. Small Red	Red Kidney	Total 1/
	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/	1,000 bags 2/
1921	90.8	43.4	20.9	289.7	103.9	14.0	0.8	9.5	1.0	0.9	574.9
1922	4.6	0.4	41.3	25.3	8.1	37.1	5.7	1.2	35.4	3.4	162.5
1923	26.7	1.2	147.3	16.3	11.7	14.2	3.6	5.3	27.3	9.0	263.6
1924	21.8	6.2	217.6	103.3	52.4	4.4	4.4	8.0	7.4	2.1	427.6
1925	3.5	1.0	16.8	15.7	16.4	3.5	0.2	5.5	8.8	3.6	75.0
1926	45.3	9.3	74.0	41.6	16.5	44.1	0.3	1.9	25.3	0.8	259.1
1927	166.9	67.3	63.1	2.5	3.6	117.8	5.7	5.2	10.5	8.4	451.0
1928	15.1	5.0	44.3	8.7	0.8	44.0	5.9	2.3	35.7	6.2	168.0
1929	2.8	1.2	11.6	1.0	0.1	1.6	0.5	0.4	22.2	1.1	42.5
1930	16.3	2.7	5.3	25.0	1.2	23.8	0.1	0.3	7.4	0.2	82.3
1931	74.6	102.7	101.7	86.7	8.1	195.7	3.6	0.5	13.3	3.3	590.2
1932	93.1	147.6	51.9	98.2	9.5	202.8	6.7	15.0	1.9	54.9	681.6
1933	47.3	68.0	27.1	27.6	1.7	57.7	0.3	3.9	1.5	4.5	239.6
1934	125.3	110.5	83.8	142.2	0.8	167.2	1.2	0.9	2.3	8.5	642.7
1935	87.2	115.8	29.0	98.2	0.3	40.9	6.6	4.7	1.8	8.0	392.5
1936	26.4	21.4	254.9	47.6	0.2	10.6	3.6	25.8	6.6	0.9	398.0

Compiled from Bean Market Information Bulletins of the Federal State Marketing Service, and from the California Fruit News, quoting reports of the California Bean Dealers Association.

1/ Carry-over figures are stocks held in California warehouses on the first of August, September, or October, whichever was the lowest quantity reported. Figures for 1921, however, are all for September 1. Totals are therefore not accurate for any one month.
2/ Bags of 100 pounds.

Table 7.-Supply and disappearance of dry edible beans in the United States, 1921-22 to 1936-37

Item	Year beginning Sept. 1921-22	1922-23	1923-24	1924-25	1925-26	1926-27	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37
	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/	1,000 bags1/
Supply																
Production	6,085	7,901	9,587	9,099	11,709	11,024	9,737	10,574	12,278	14,133	12,914	11,005	12,771	11,393	14,323	11,122
Carry-over: beginning of year	2,080	800	1,300	1,500	1,800	1,300	1,480	180	250	930	2,065	1,662	1,250	2,000	1,150	1,000
Imports for consumption 2/	483	1,135	357	688	529	602	1,325	591	1,311	698	18	63	147	389	152	
Total	8,648	9,836	11,244	11,287	14,038	12,926	12,542	11,345	13,839	15,761	14,997	12,730	14,168	13,782	15,625	
Distribution																
Exports	607	393	411	294	347	334	242	171	170	174	87	79	68	55	87	
Shipments to non-contiguous territory	169	155	197	205	276	245	275	283	189	225	328	407	333	271	357	
Carry-over: end of year	800	1,300	1,500	1,800	1,300	1,480	180	250	930	2,065	1,662	1,250	2,000	1,150	1,000	
Total	1,576	1,848	2,108	2,299	1,923	2,059	697	704	1,289	2,464	2,077	1,736	2,401	1,476	1,444	
Disappearance	7,072	7,988	9,136	8,988	12,115	10,867	11,845	10,641	12,550	13,297	12,920	10,994	11,767	12,306	14,181	
	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Per capita disappearance 3/	6.5	7.2	8.1	7.9	10.5	9.3	10.0	8.8	10.3	10.8	10.4	8.8	9.3	9.7	11.1	

See tables 1 and 4 for production and trade data. Carry-over figures are rough approximations.

1/ Bags of 100 pounds.

2/ Imports minus reexports until January 1, 1934; thereafter imports for consumption.

3/ Population January 1.

Table 8.-Average price per 100 pounds of dry edible beans, by selected varieties, 1921-22 to 1936-37

Year beginning Sept.	Pea 1/	Great Northern 2/	Pinto 3/	Pink 4/	Cranberry 4/	Red Kidney 1/	Standard lima 4/	Baby lima 4/	United States average farm
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
1921-22	6.81	4.95	3.85	5.29	7.17	8.53	7.64	7.50	4.76
1922-23	7.68	5.50	5.40	5.40	7.03	7.88	7.86	9.91	5.82
1923-24	5.92	5.80	4.55	4.86	5.67	7.88	10.51	10.55	5.37
1924-25	6.42	5.80	4.60	7.54	7.40	10.26	13.90	12.75	5.61
1925-26	5.44	4.80	3.85	5.52	7.55	9.80	9.78	9.40	5.00
1926-27	5.88	4.60	4.85	5.09	6.62	7.98	6.10	5.16	5.04
1927-28	8.55	5.00	5.20	5.54	6.74	8.50	7.48	7.64	5.52
1928-29	10.26	6.40	5.50	6.67	8.17	8.62	12.32	10.85	7.27
1929-30	7.87	6.00	4.95	5.92	7.33	10.10	11.70	10.47	6.77
1930-31	5.51	3.80	2.80	3.84	5.63	8.87	6.84	4.90	4.19
1931-32	2.99	1.70	1.40	3.03	2.63	3.03	4.25	2.83	2.14
1932-33	2.58	1.50	2.20	3.09	3.87	3.67	4.77	4.00	2.01
1933-34	3.31	2.20	2.90	3.19	5.08	4.48	5.52	3.73	2.79
1934-35	3.73	3.15	5.50	5.42	5.67	5.89	5.56	3.92	3.56
1935-36	3.29	2.50	2.75	3.09	3.78	5.84	6.63	5.33	2.93
1936-37 5/	7.49	4.25	4.05	5.04	6.60	8.10	7.36	5.80	5.02

Compiled from New York Producers Price Current, daily, and California Fruit News, weekly; farm prices are from the Division of Crop Estimates.

1/ New York wholesale prices, representing prevailing values of the commodity and grade specified as indicated by sales from receivers to wholesale distributors.
2/ Idaho farm price.
3/ Colorado farm price.
4/ F.o.b. rail, California, straight cars.
5/ Preliminary.

Table 9.- Equations showing the relationship between prices of certain classes of beans and several quantity factors, in link relative terms, 1922-23 to 1934-35

Price of:	As a function of:											a	$\frac{R}{H}$
	Income of industrial workers	Production of Pea beans	Production of Great Northern	Production of Pinto	Supply of Pinto	Supply of Cranberry	Production of Red Kidney	Supply of Standard Lima	Supply of Baby Lima	Total production all beans	Production of all colored beans	Production of all lima beans		
Pea beans														
Regression coefficients	1.336	-0.611									-0.343	-0.194	89.2	0.931
Standard errors	(±0.226)	(±0.159)									(±0.116)	(±0.099)		0.894
Coef. of determination	0.626	0.258									-0.001	-0.017		
Great Northern 1/														
Regression coefficients	1.776		-0.321										-37.7	0.908
Standard errors	(±0.314)		(±0.204)											0.880
Coef. of determination	0.866		-0.042											
Pinto 2/														
Regression coefficients	384.7			3/ 0.217							4/0.927		-775.6	0.918
Standard errors	(±0.765)			(±0.074)							(±0.372)			0.888
Coef. of determination	0.437			0.284							0.121			
Pink														
Regression coefficients	1.411				-0.859						5/-0.338	-0.322	122.8	0.902
Standard errors	(±0.310)				(±0.334)						(±0.140)	(±0.160)		0.848
Coef. of determination	0.280				0.280						0.131	0.122		
Cranberry beans														
Regression coefficients	1.366					-0.409						-0.380	57.4	0.890
Standard errors	(±0.268)					(±0.106)						(±0.119)		0.850
Coef. of determination	0.435					0.250						0.107		
Red Kidney														
Regression coefficients	1.157						-0.443					-0.422	81.0	0.868
Standard errors	(±0.272						(±0.135)					(±0.125)		0.820
Coef. of determination	0.364						0.240					0.150		
Standard Lima														
Regression coefficients	1.176							-0.669	-0.223				84.8	0.915
Standard errors	(±0.257)							(±0.123)	(±0.115)					0.885
Coef. of determination	0.254							0.489	0.094					
Baby Lima														
Regression coefficients	0.989							-0.372	-0.631				118.1	0.911
Standard errors	(±0.283)							(0.135)	(±0.126					0.879
Coef. of determination	0.171							0.148	0.511					
Total beans														
Regression coefficients	1.486									-0.598			16.5	0.932
Standard errors	(±0.183)									(±0.204)				0.918
Coef. of determination	0.896									-0.027				

1/ Data for period 1925-26 - 1934-35.
2/ Logarithms of link relatives of income.
3/ Reciprocals of link relatives of Pinto production.
4/ Reciprocals of link relatives of production of colored (excluding Pinto) beans.
5/ Production of colored (excluding Pink) beans.

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